



This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

- + *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.
- + *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.
- + *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.
- + *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at <http://books.google.com/>

UC-NRLF



\$B 117 084

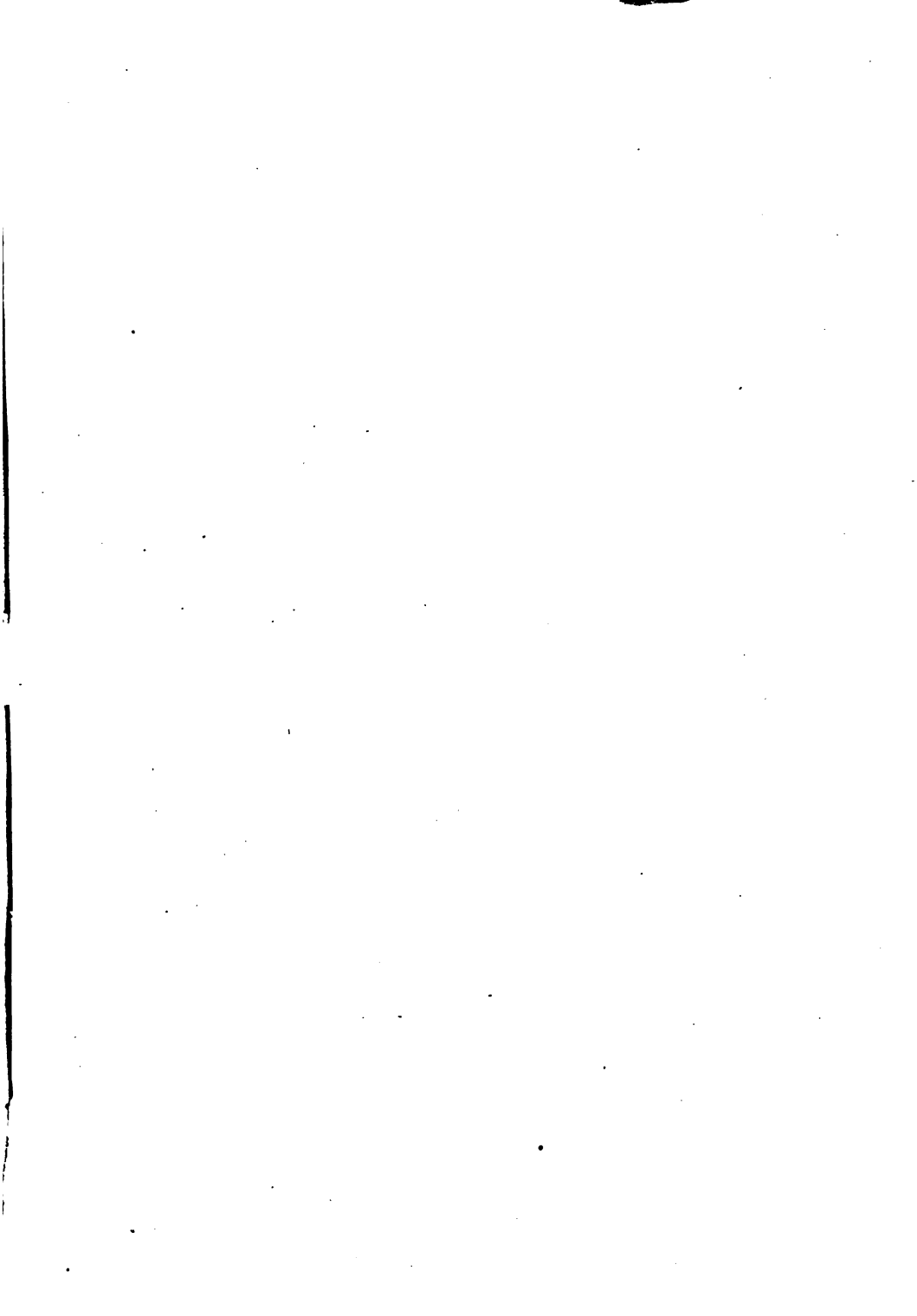
THE LYCHEE AND LUNGAN



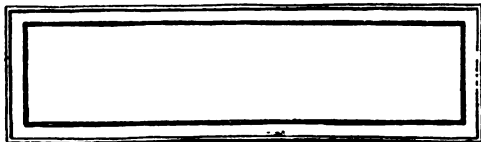
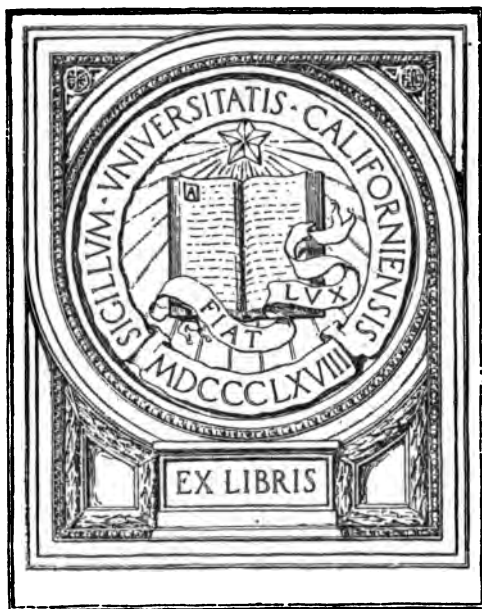
G. WEIDMAN GROFF

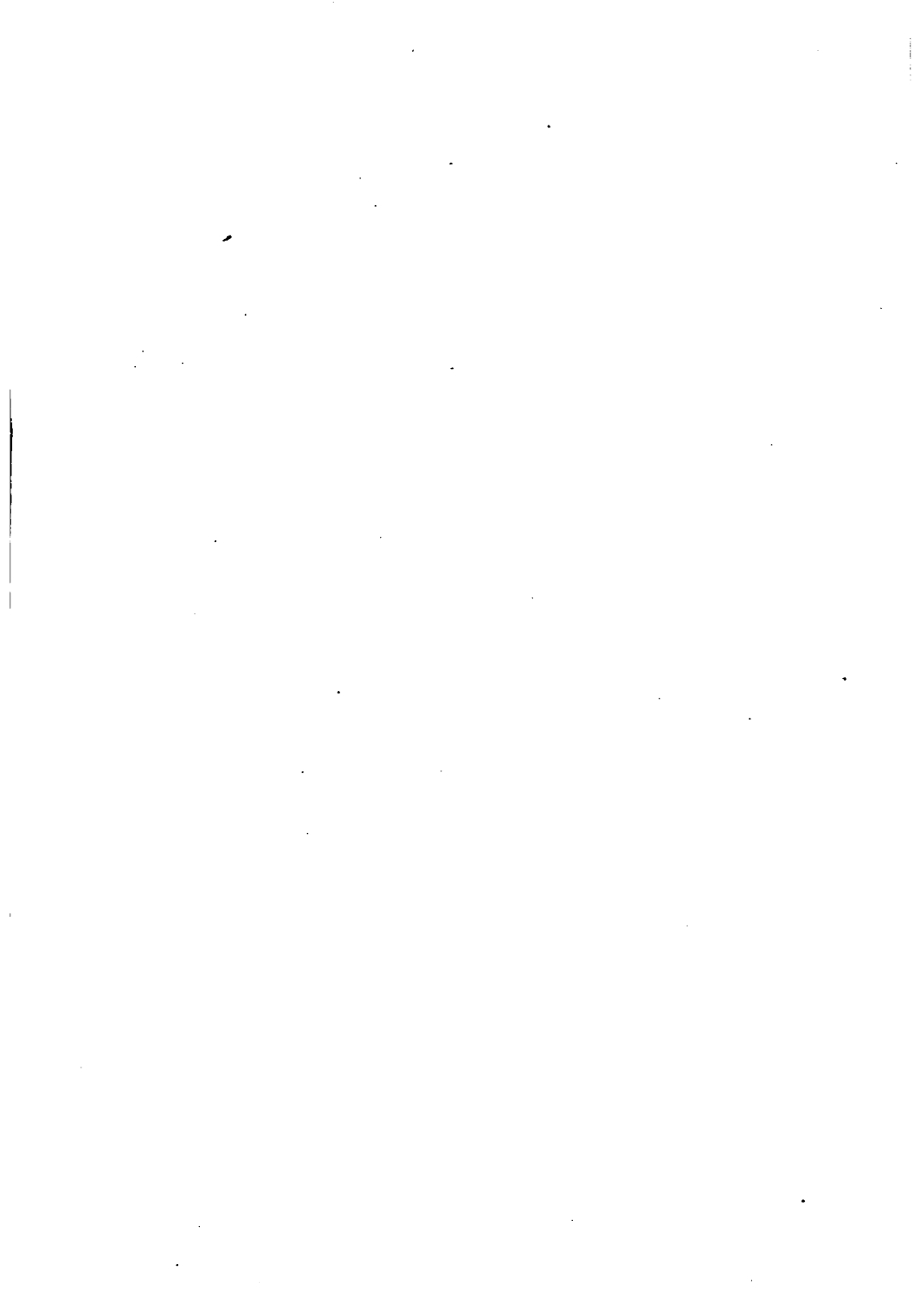
GIFT OF
HORACE W. CARPENTIER

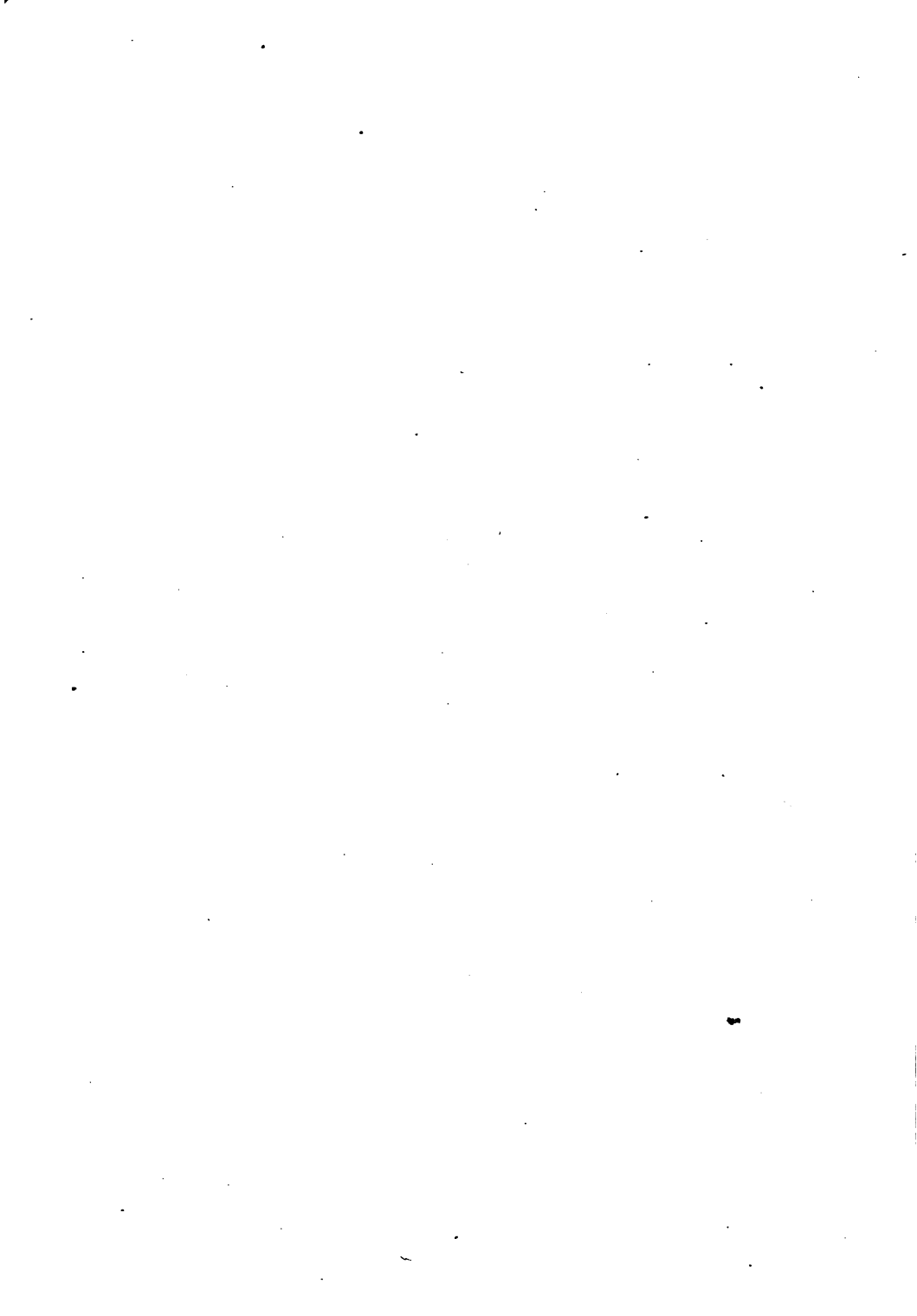




GIFT OF
HORACE W. CARPENTIER







UNIV. OF
CALIFORNIA



Reproduction of a Lychee Painting Attributed to
the Sung Emperor, Hui Tsung, and Entitled
"The Ch'en Purple Lychee Embroidered Fragrant Bag."

Permission of the Metropolitan Museum of Art.

PLATE II



Frontispiece.—A Kwangtung Lychee Landscape.

The Lychee and Lungan

BY

GEORGE WEIDMAN GROFF

Representative, The Pennsylvania State College Mission to China,
Professor of Horticulture and Director of Agricultural
Work, Canton Christian College

WITH ELEVEN APPENDICES, INCLUDING CONTRIBUTIONS BY
FREDERICK V. COVILLE, WALTER T. SWINGLE, EDWARD GOUCHER, AND MICHAEL J. HAGERTY
ALL OF THE UNITED STATES DEPARTMENT
OF AGRICULTURE

Sixty-eight Illustrations and One Color Plate

NEW YORK
Orange Judd Company
Canton Christian College

LONDON
Kegan Paul, Trench, Trubner & Co., Limited

CANTON, CHINA
Canton Christian College

1921

TO VNU
AIRBORNE

SP 377
L507

1100

COPYRIGHT, 1921, BY
CANTON CHRISTIAN COLLEGE
All Rights Reserved

Canton

PRINTED IN CHINA AND U.S.A.

TO

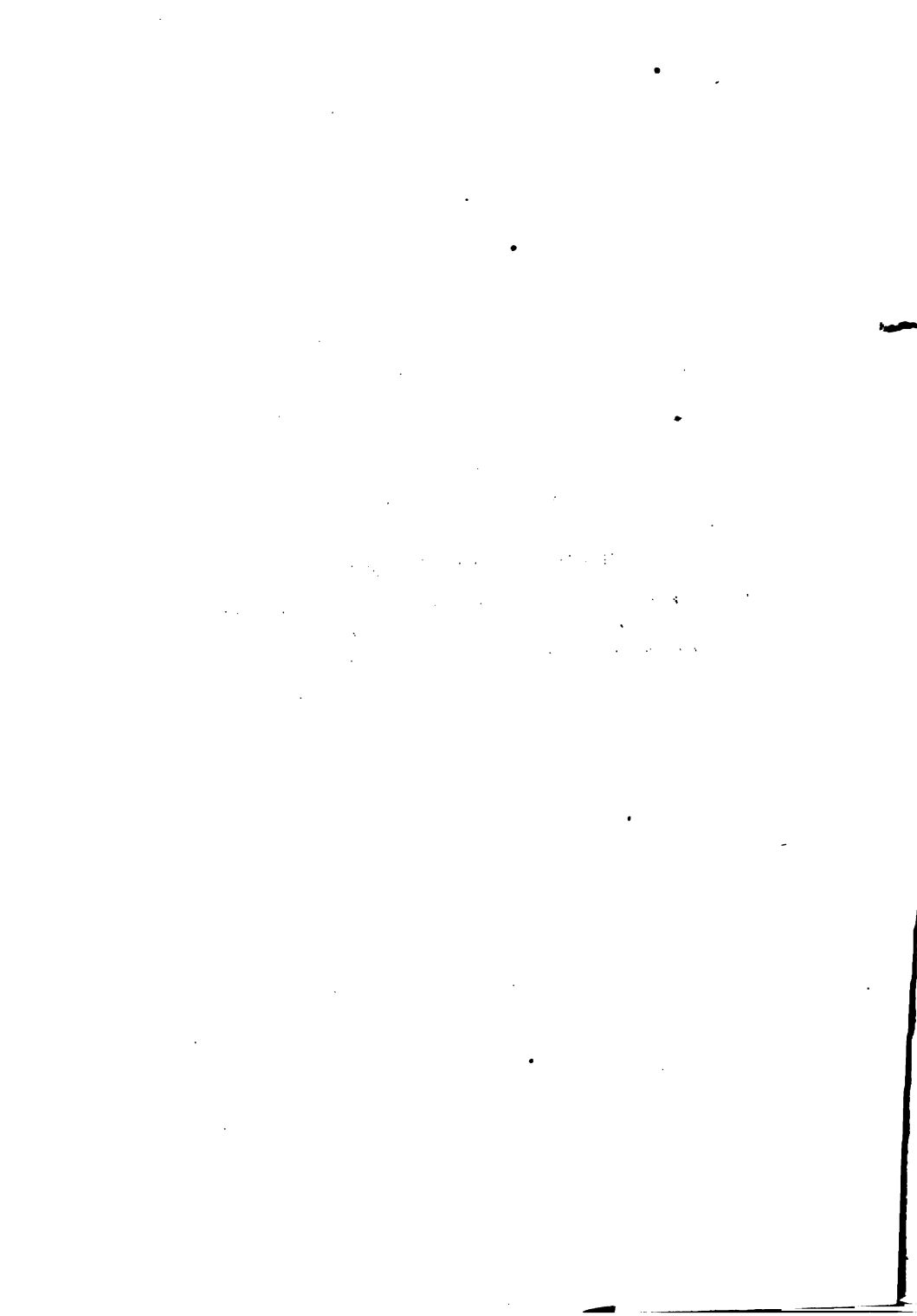
Walter T. Swingle

AND HIS WIFE

Maudie Kellerman Swingle

WHOSE KNOWLEDGE OF CHINA'S PLANTS AND LITERATURE
AND DEEP INTEREST IN CHINA
HAVE BEEN A CONSTANT INSPIRATION AND HELP
IN THIS STUDY

466566



PREFACE

Most occidentals resident in South China have joined the Chinese in their zealous enthusiasm for the lychee. It has been the writer's privilege to have lived for twelve years in the very heart of one of the two famous lychee producing regions of China. Shortly after arrival upon the South China field, as representative of the Pennsylvania State College Horticultural Mission at the Canton Christian College, I was asked to make a thorough study of the lychee and lungan in their native region. The present work is the result of these investigations.

The western horticulturist should naturally find in this work something of interest with regard to fruits of a family with which he has doubtless had little acquaintance. Interesting theories and practices of Chinese fruit growers should be of some value to fruit growers of the West. And to those interested in the introduction of the lychee and lungan into other lands these investigations should lead to a more adequate understanding of the peculiar characteristics of these fruits, without which there is little hope of successful culture.

It is hoped that this work will be of interest not only to horticulturists but also to those of East and West who are interested in the past, present and future of China. The historical setting of the lychee and lungan as revealed in Chinese literary works should be of some value to students of Chinese literature and Chinese history. An acquaintance with these works should arouse the western world to a realization of the importance of Chinese literature as a possible source of knowledge for present-day progress in scientific development. To the student of geography and world affairs, South China, and its industrious, self-sacrificing people, should occupy a more prominent position because of knowledge with regard to this people in this one special phase of their endeavor; and because of the interest of South China's widely travelled emigrants in carrying the gospel of their favorite fruit to the ends of the earth.

The writer desires to express his appreciation for valuable assistance in the field to his many Chinese students and friends, without whose help the work would have been very difficult. To the many Chinese orchardists whom I have interviewed and to the Chinese nurserymen in whose homes I have been entertained a wish is expressed that Chinese investigators and students may have as cordial treatment in the hands of the western public. To Dr. David Fairchild and his staff in the Office of Foreign Seed and Plant Introduction of the United States Department of Agriculture the writer is indebted for access to information whereby he could better understand the real problems involved in the introduction of these fruits into the United States; especially to the late Mr. S. C. Stuntz for his valuable suggestions and corrections in the preparation of the original manuscript. Special obligation is expressed to Dr. and Mrs. Walter T. Swingle for encouragement and their untiring efforts to assist in a thorough study of the European and Chinese literature and in a more complete understanding of some of the vital phases of the work. Dr. Swingle made many valuable suggestions with regard to the possibilities in the use of other species of the "lychee group" for hybridizing and stock. Thanks is due Dr. S. W. Fletcher, Professor of Horticulture at the Pennsylvania State College for encouragement in the study and for reading the original manuscript; and to Prof. I. L. Foster, Professor of Romance Languages, for translation of some of the European literature. In the study of the Chinese literature the writer is indebted for the assistance of one of his old students, Mr. Li Ch'eng Lan (Li Ch'ing Lan, 李澄瀾) and to Mr. Kuo Hua Ssin (Kwok Wa Sau 郭華秀) for assistance in checking investigations. To Mr. Michael J. Hagerty of the Office of Crop Physiology of the United States Department of Agriculture acknowledgement is due for a translation of Ts'ai Hsiang's *Li Chih P'u*; and to Mr. Ho Hung P'ing (何鴻平) of the Canton Christian College for a translation of Wu Ying K'uei's *Ling Nan Li Chih P'u*.

In 1917 it was an agreeable surprise to return from China to the United States and to find in the Library of Congress at Washington an excellent collection of Chinese works, with a system of classification facilitating ready reference. It is no exaggeration to say that this work, in its present form, would not have been possible without reference to these valuable works whereby the writer has been able to check original investigations in his own region and to

PREFACE.

secure valuable information regarding the culture of these fruits in other sections of China and Indo China. The large collection of Chinese provincial, prefectural and district gazetteers found in the Library of Congress has led to a source of information of extreme value. A careful study of the Chinese writings on the lychee, including these geographical works, has resulted in a strong conviction that a knowledge of Chinese literature is not only essential in any study of the varieties, culture and uses of cultivated plants in China, but that such knowledge is of the greatest value in any attempt to introduce these plants into successful culture in the West. The enthusiasm for Chinese literature shown by men like Dr. Walter T. Swingle should in the years to come awaken the western world to the treasures stored within its pages. Dr. Swingle's inspiration and Dr. Herbert Putnam's hearty co-operation has brought the Chinese collection in the Library of Congress to its present good condition and I believe this is destined to become the very best collection outside of China itself.

It is not always easy to be consistent in the romanization of Chinese names. But except where indicated by the phrase "in Cantonese", or otherwise, the spelling followed is always the Mandarin according to Herbert A. Giles Chinese-English Dictionary; except in the names of places with post offices, when the Postal Guide, issued by the Ministry of Communications of China, is followed. As the Mandarin romanization of the names of Kwangtung men, places and fruits is hardly intelligible to those working in the Canton district, the Cantonese romanization according to the Eitel-Genähr Chinese-English Dictionary in the Cantonese Dialect has in many cases been placed in parenthesis with the Chinese characters.

In conclusion the writer wishes to express his gratitude to Mr. Kenneth Duncan of the Canton Christian College for valuable suggestions in the preparation of the manuscript for the press and for his willingness to supervise the publication of the work in the writer's absence.

G. WEIDMAN GROFF

Ling Nam, Canton, China,

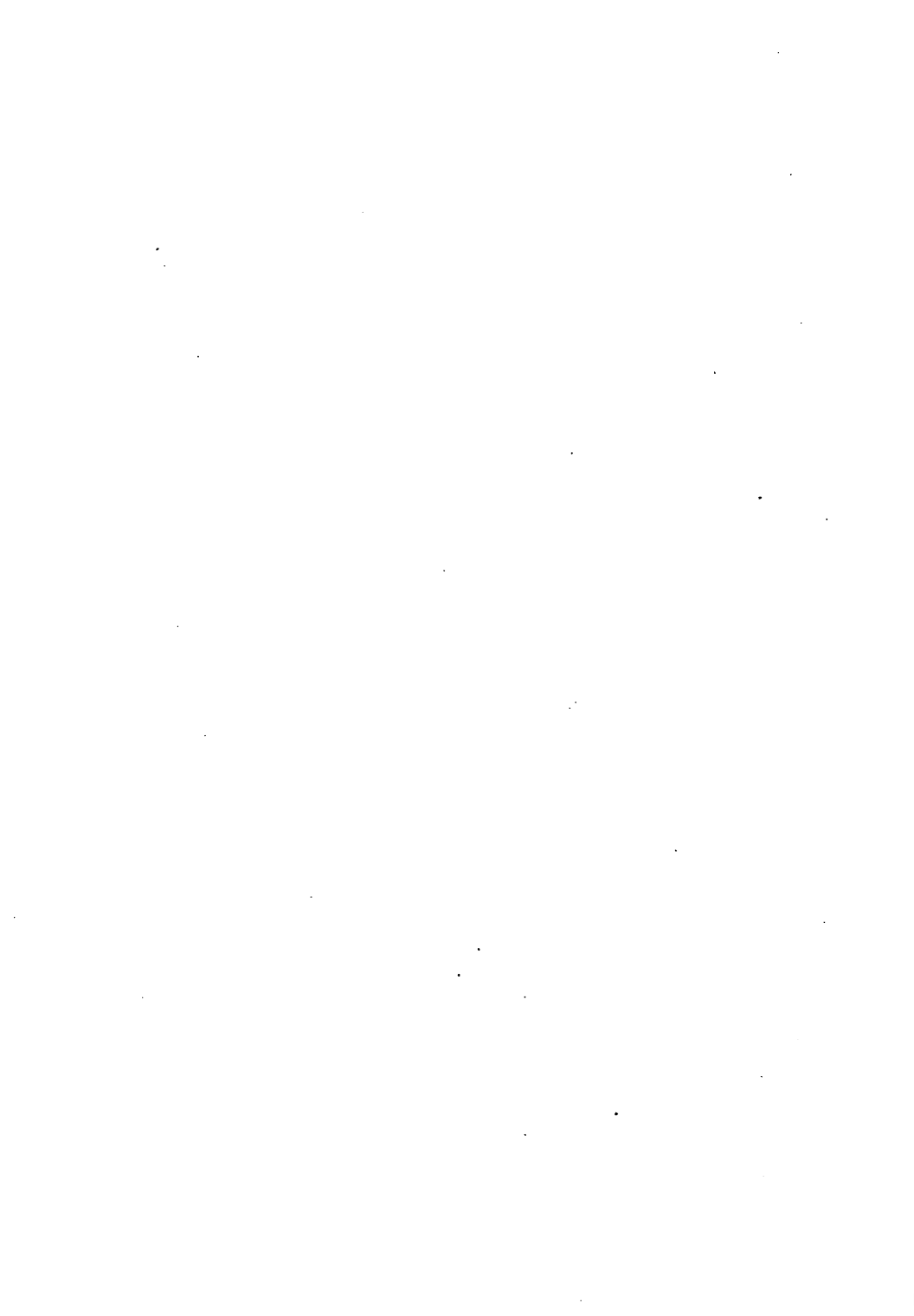
TABLE OF CONTENTS

	Page
PREFACE	1
I. Introduction	5
II. Origin of the Names Lychee (荔枝) and Lungan (龍眼) and English Spelling and Romanization..	13
III. Chinese Literature on the Lychee.....	16
IV. European and American Literature on the Lychee and Lungan	23
V. Botany of Four Important Sapindaceous Fruits	32
VI. The South China Region, the Home of the Lychee and Lungan	44
VII. Some Important Ling Nan Centers.	47
VIII. The Climate Best Adapted to the Lychee and Lungan	54
IX. Soils Adapted to the Lychee and Lungan and Cultural Methods	58
X. Methods of Propagation	64
XI. The Lychee and Lungan in Commerce	71
XII. Enemies	82
XIII. Varieties of the Lychee.....	87
XIV. The Lungan.....	103
XV. The Introduction of the Lychee and Lungan into Other Lands	111
XVI. Summary.....	116

APPENDICES

I. Bibliography of Chinese References on the Lychee and the Lungan.....	119
II. Bibliography of Western References on the Lychee...	127
III. Canton Weather Table.....	142
IV. Present-Day Varieties of Kwangtung Lychee and Lungan.....	143
V. Analyses of Lychee and Lungan Fruits.....	149

VI.	The Lychee a Mycorhizal Plant. FREDERICK V. COVILLE.....	Page 151
VII.	Lack of Winter Dormancy and the Low Zero Point of Growth of the Lychee Limiting Factors in Its Culture in Florida. WALTER T. SWINGLE.....	153
VIII.	Rooting Lychee Cuttings by Means of a High Temperature and High Humidity Process. EDWARD GOUCHER.....	157
IX.	Sung Chio's Account of the Organization of a Lychee Club at P'ut'ien, Fukien Province, during the Ming Dynasty. Translated by Michael J. Hagerty, assisted by Ch'ên Ts'ing-hua.....	160
X.	Detailed Description of Illustrations.....	164
XI.	Supplementary Notes.....	171
POSTFACE		173
ERRATA		175
INDEX		176



THE LYCHEE (荔枝) AND LUNGAN (龍眼)

CHAPTER I

INTRODUCTION

Few world centers are so conspicuously characterized by two distinct and native fruits as is South China by the lychee and the lungan. He who in the West has had a Chinese numbered among his friends or acquaintances has doubtless seen the lychee in its dried form. This so-called "Chinese" or "lychee nut" has for years been the favorite Christmas or New Year gift of Chinese living abroad. As a result of their generosity it is to-day one of the most popular Chinese agricultural products on the Western markets and is of increasing commercial importance. The lungan is even more rarely met in the West than is the lychee. But he who has lived or visited in South China in the summer season will never forget the curious little "dragon-eye" which follows on the markets immediately after the lychee and which is quickly recognized as the little brother of this fascinating fruit.

The lychee (荔枝), *Litchi chinensis* Sonn., indigenous to South China and cultivated extensively only in that region, is marketed and relished throughout the length and breadth of the Chinese Republic. It is famous throughout Asia where it is preserved in various forms and is used in a variety of fancy dishes. The dried form is commonly served on the tables of Pacific steamships, and in Europe and America it appears in Chinese restaurants and in the homes of connoisseurs.

The lungan (龍眼) *Euphoria longana* Lam., is similarly dried and used by the Chinese but to a more limited extent than is the lychee. In medicine, however, it has a wider use than has the lychee. In recent years both of these fruits have appeared in canned form, preserved in sugared syrup. The labels on the tin cans are printed in both Chinese and English and are very similar to those of western fruits now rapidly making inroads on Chinese markets. In both the canned and dried forms the lychee and lungan are delicious products; but they cannot be fully appreciated except when eaten freshly picked from their attractive evergreen trees.

It is a surprising fact that among the varied fruits of the Western Hemisphere one does not find a single species belonging to the sub-family *Nephelieae* of the family *Sapindaceae* to which these fruits belong. For centuries this group has provided the thickly populated regions of southern Asia and the East Indies with several of their most delicious and refreshing fruits. Four distinct species, representing three closely related genera, and each with a number of varieties, are grown in China, the Malay Peninsula, Java, Sumatra and British India. A few scattered trees have only recently found their way into the West Indies, Panama, southern Florida and southern California where climatic conditions are somewhat similar to those in the region in which these fruits are native. It is a singular coincidence that although species of *Litchi* and *Euphoria* appear in the wild state in the Philippines, the two edible species of South China have never been extensively cultivated in those islands. In the Hawaiian islands one non-edible species of the family exists. Trees of the edible forms, introduced from South China by Chinese residents in Hawaii, have for a number of years borne fruits at irregular intervals. These trees have only recently attracted the attention of horticulturists. The cultivation of the best varieties of the lychee and lungan, or of the two allied more tropical species of *Nephelieae*, might provide a paying industry for some of these regions in question. They would certainly be worthy additions to the fruits now on the markets of the western world.

The four most widely cultivated fruits of *Nephelieae* are the rambutan and pulassan of the malaysian tropics and the lungan and lychee of the sub-tropical Asiatic Mainland. The latter, the best of the four, is decidedly the most promising for those regions in which the fruits could be grown for sale in the United States. If the lychee were given the strict attention of successful fruit growers, and its cultural peculiarities carefully studied, it should be found that certain varieties are especially adapted to the low, wet, otherwise useless land of some of these areas; while other varieties not so promising might be grown on the hills. The lungan is a hardier species than the lychee and as such should find a place in the more northern extremities of sub-tropical regions. It is a fruit worth introducing and is a most valuable ornamental. Experimentally it will prove of interest as a stock and for hybridizing with the lychee. The rambutan and pulassan, *Nephelium lappaceum* Linn., and *Nephelium mutabile* Blume, are strictly tropical forms and should prove valuable introductions in regions too warm for the lychee and lungan.

Chinese poets have sung praises to the lychee for centuries while Chinese writers have written of the value of the lychee and lungan in the home, in medicine and in commerce. In times past good Chinese officials have encouraged the cultivation of these fruits by protecting the parent trees of choice varieties, by disseminating information regarding cultural methods and by encouraging Chinese writers to make careful descriptions of the best varieties. Bad officials have greatly discouraged these important fruit industries by the custom, formerly so rampant in China, of imposing tribute upon the growers. The importance of the lychee in the eyes of the Chinese is evinced by the fact that there are no less than nine treatises on the lychee by famous authors, beginning with that of Ts'ai Hsiang (蔡襄)¹ in A. D. 1059 and extending to that of Wu Ying K'uei (吳應達)² in 1826. The latter author has written most interestingly of the origin of the name lychee.

Travellers to China from the earliest times have reported the merits of the lychee and have encouraged its introduction into Europe and the United States. But like many things of Chinese origin, this important fruit is practically unknown on the Western Hemisphere. Such a well known authority as Dr. Augustine Henry, who knows well both European and Oriental fruits, has privately written with regard to the lychee, "It is one of the very finest fruits in the world, not excepting the apple and the pear." A Portuguese writer³ does not hesitate to say of the lychee, "It is the most tasty and beautiful fruit that God has created in the Universe." In fact the lychee has for many years been a favorite subject of foreign writers but their treatment has usually been as brief as their access to knowledge regarding it. One very recent writer⁴ tersely remarks in a three hundred word article, "One of the daintiest packages that have ever been wrapped by Nature's hand is the little spherical litchi fruit. No one, whether he is a

¹ TS'AI HSIANG (蔡襄), Li Chih P'u (荔枝譜) in *Ku Chin Tu Shu Chi Cheng* (古今圖書集成), *Po Wu Hui Pien* (博物彙編), *Ti'ao Muh Tien* (草木典), section 273 (二百七十三卷), *Li Chi Pu* 1 (荔枝部一) pages 1-5 (第一頁至第五頁).

² WU YING K'UEI (吳應達) *Ling Nan Li Chih Pu* (嶺南荔枝譜) in *Ling Nan I Shu* (嶺南遺書), book 59 (第五十九本) and in six sections (共六卷).

³ MONTEIRO DE CARVALHO, JOSE, *Diccionario portuguez das plantas, arbustos*, page 316.

⁴ WALKER, ROBERT SPARKS, in *The Guide to Nature*, Vol. XII, No. 3, page 34.

student of nature or not, can examine the litchi without admiring its beauty and the sanitary method by which the fruit is preserved."

Considerable effort has been made to introduce the lychee and lungan into western countries. William Roxburgh (1759-1815)¹ reports, "This very famous tree is now common in Bengal. It was originally brought from China." In the early part of the 19th century the lychee and lungan reached Europe. In the Transactions of the Horticultural Society of London² is recorded, "Two species of *Dimocarpus* have been introduced into our gardens: the *D. Litchi*, and *D. Longan*. They are both natives, of the southern part of China, where they are known as the *Litchi*, and the *Long yen* and much cultivated; they have also been transferred thence to different places in the East Indies." The lychee reached Trinidad before 1880.³ Florida grew the fruit as early as 1883 when Robert Manning said, "I tasted it and found the flavor excellent."⁴

Since the year 1907 the Office of Foreign Seed and Plant Introduction of the United States Department of Agriculture has run a special project to introduce the lychee into culture and since that time it has been carefully studied at home and abroad and information regarding it has been assembled. In 1911 a tree at Santa Barbara, California, bloomed but failed to carry its fruits to maturity. In 1914 it fruited. In July, 1916, trees which had been sent to Reaser Brothers of Oneco, Florida, by the Office of Foreign Seed and Plant Introduction, bore fruit of exceptionally fine quality.

Many problems are involved in the successful introduction of the lychee and lungan into other lands. The climate and soils best adapted to their successful culture must first be studied in their native home. The tendency of these fruits to variation, and their ready response to culture, is evident from the large number of varieties which have been carefully listed by the Chinese in both literature and commerce. A study of these varieties reveals a marked range in earliness, hardness, productivity, color, size of fruit and seed; and in

¹ ROXBURGH, WILLIAM, in *Flora Indica or Descriptions of Indian Plants*, Vol. II, page 269.

² *Transactions of the Horticultural Society of London*, 2d Edition, Vol. II, pages 402 and 403.

³ TRINIDAD, BOTANICAL DEPARTMENT, *Bulletin of Miscellaneous Information* (Quarterly), January 1907, No. 53, page 177.

⁴ CORSA, W. P., *Nut culture in the United States*, embracing native and introduced species, U. S. Department of Agriculture, Division of Pomology, page 105.

the general character such as flavor, fragrance, juiciness and amount of rag. In the general classification of the varieties of the lychee one of the most interesting, and possibly significant groups is that which the Chinese call the "water lychee" or "shui chih" (水支) and "mountain lychee" or "shan chih" (山支) classification.

The lychee and the lungan are not without their natural enemies. Very little is done in China to control these enemies. A scientific study with regard to them is imperative in order both to advance the industry in China and to prevent these enemies from gaining a foothold in other countries in which these fruits can possibly be grown. The most common insect attacking the lychee is a relative of the well known "stink bug"—a highly decorated species of the family *Pentatomidae*. The second most conspicuous enemy is a mite, apparently an undescribed species of *Eriophyes* which cause velvety galls on the leaves of the trees. Several species of *Scarabeidae* are especially troublesome to upland growers. A tree borer is also common and the Chinese fight it most ingeniously by the use of fire crackers. Minor, superficial fungi can be found on the leaves of the trees but the thick, tough, glossy nature of the leaves makes their susceptibility to fungi very slight indeed. But parasitic algae are very common on both trunk and leaf.

One of the most fascinating horticultural studies in China is that of propagation. A Chinese plant propagator will never make an attempt to give a scientific explanation of his interesting practices; rather is he content to throw about his art an air of mysticism. But one always leaves the haunt of the Chinese gardener or nurseryman with the inward feeling that the latter has his art at the right place—his fingers' tips; and that one is leaving with many whys and wherefores still unexplained. That the western world has much to teach China in the modern organization and systematic application of scientific nursery practice is evident on all hands. But it is folly for the West to feel that there is nothing to be learned from Chinese patience, perseverance and skill in the utilization of nature's best for the use of man. In this, as in many other fields, the great opportunity open to the modern trained student in China is to bridge the immense chasm that often exists between the practices evolved from organized knowledge and those that are the result of centuries of experience and intuitive perception.

Most of the lychee trees grown in the vicinity of Canton have been propagated by the very common method known as

"pok chih" (駁枝). This is a process of layering which the modern horticulturist can rightly term "Chinese air-layering." It is practically the same as "Gootee" layering of India. All Cantonese gardeners are excellent manipulators of this method and a great majority of the trees and shrubs, including citrus fruits, of South China are thus propagated. After the trees have been rooted by this process they are set out in nursery beds or planted into pots. When they are raised for permanent planting a ball of earth at least a foot in diameter, held in place by means of rice straw, remains attached to the roots. The nursery business as seen for example at the village of Fang Yung (鳳涌), near Canton, has become quite an industry and during the planting season one often sees boat loads of lychee nursery stock.

Lychee are rarely grown from seed; lungan more often. The Chinese consider that in a region where temperature and humidity so greatly facilitate layering there is little reason to depend upon seedlings. Then, too, seeds of the lychee are very short lived and cannot be kept viable for more than four or five days, except under very moist conditions. In the propagation of the trees in other lands, however, the seedling method may be advantageous, especially until a large number of trees are at hand. J. E. Higgins¹ in his bulletin cites some interesting experiments with regard to the use of seeds in propagation.

In the greenhouses at Washington the United States Department of Agriculture has clearly demonstrated that lychee can be successfully grown from cuttings. Inarching is widely practiced by the Chinese and in the propagation of some of the best varieties of the lychee and lungan they often resort to this method. The small seeded "No Mi Chih" (糯米糍) lychee is often thus propagated. One often sees high headed tops of this variety growing on trunks of the hardy, mountain or "shan chih" (山支) type. Chinese recognize the art of grafting but I have not seen them practice budding. But cleft grafting, known as "tsieh chih" (接枝) is quite widely practiced on both the lychee and lungan. In the famous fruit region of "Lo Kang Tung" (羅岡洞), twenty to thirty miles northeast of Canton, one sees some very successful specimens of cultivated lychee which have been cleft grafted upon the hill type. In fact this practice is doubtless the foundation upon which the large commercial lychee industry of Lokang (羅岡) has been founded.

¹ HIGGINS, J. E., *The Litchi in Hawaii*, Hawaii Agricultural Experiment Station, Bulletin No. 44, pages 7 and 8.

The botany of the lychee and lungan reveals the fact that we can look with promise to regions remote from those of native habitat for stocks upon which to work these interesting fruits. In particular the wild lychee of the Philippines, *Litchi philippinensis* Radlk., offers great promise of being found useful as a stock, since it is the species most closely related to the cultivated lychee and since it has peculiarities of advantage as a stock. The lungan also has an allied Philippine species, *Euphoria cinerea* Radlk., which might be useful in lungan culture. J. E. Higgins¹ has clearly shown that "there is no difficulty in securing a union of the litchi with the lungan." Chinese also report that there are lychee trees growing upon the lungan roots but its practicability is very questionable as specimens are rare. It is apparent that there is an open field for a series of interesting and helpful experiments in the propagation and hybridization of these attractive fruits. Such experiments should prove of great value to China and to other countries attempting to introduce the lychee and lungan under conditions not so favorable as in their native habitat. Drought and frost resistance are two factors to be kept definitely in mind in this work; and soil variations should be carefully studied.

The inhabitants of the South China region, the home of the lychee and the lungan, should take great pride in these two native fruits. Of the six provinces which geographically comprise South China, only two, Kwangtung (廣東) and Fukien (福建), grow the fruits extensively. Szechwan (四川) to the northwest, and not included among the provinces of this region, produces some lychee and lungan. These fruits are known to grow as far south as Siam. But Kwangtung and Fukien are the two great lychee-lungan provinces and their history interestingly discloses that for centuries they have striven with one another for supremacy in culture and export trade. The Ling Nan (嶺南) and Hsing Hwa (興化) regions of Kwangtung and Fukien respectively, are the centers of the lychee and lungan industry of China. Fukien can rightly claim priority in the literature of the lychee through Ts'ai Hsiang's treatise,² now eight hundred and sixty years old. In the early part of the eighteenth century Wu Ying K'uei (吳應遼) matched this work by the publication of his treatise² on the most famous product of the Canton region, the Ling Nan lychee.

¹ HIGGINS, J. E., *The Litchi in Hawaii*, Hawaii, Agricultural Experiment Station, Bulletin No. 44, page 11.

² See footnotes 1 and 2, page 7.

Ling Nan (嶺南) is a range of mountains, a region and a college. The college, known in Cantonese as Ling Naam Tai Hok (嶺南大學) and in English as the Canton Christian College, has appropriately centered attention upon the lychee. It is the aim and hope of this institution to establish more firmly the lychee in Kwangtung by means of a practical effort. This great fruit industry should be modernly organized and developed to its maximum in order to increase home consumption and export trade. When railroads, connecting North and South, are completed there will be an increased demand on northern markets for this famous product of the south; while foreign markets for the dried and canned products are still undeveloped. It is fitting that one of the great tasks of the Canton Christian College shall be to standardize and improve the lychee and to develop its markets. The lychee certainly deserves to be classed with the very best fruits of the world and is worthy of the name "Ling Nan" (嶺南).

CHAPTER II

ORIGIN OF THE NAMES LYCHEE (荔枝) AND LUNGAN (龍眼)

AND

ENGLISH SPELLING AND PRONUNCIATION

Wu Ying K'uei (吳應遠)¹ in the introduction of his special treatise on the lychee gives a full explanation of the origin of the name lychee and supports his claims by reference to previous works. He writes that the lychee (荔枝) has secured its name from the fact that the fruit clings so tenaciously to the twigs, thus necessitating the use of knives in separating the fruit from the branches. In the time of the Han Dynasty (漢朝), B.C. 140-86, the characters representing the fruit were written 離支. The first character 離, pronounced like the English word *lay* means "to separate" or "to leave." The second character 支, pronounced like *chee* in the English word *cheese*, means "branch." The wood of the lychee is very hard and the fruit, even when ripe, clings firmly to the twigs. These early characters, 離支, were thus an attempt to convey the idea that in gathering the fruit the *twigs* must be *separated* from the *branches* and the fruit then *separated* from the twigs. However, as knives were used in the operation of gathering the fruit the first character 離 later came to be written 荔 and to be pronounced "li" the "i" long as in the English word *ice*. The second character 支 remained the same though now it is often written 枝 with the additional radical 木, meaning "wood" or "tree", on the left which gives the word, also pronounced "chee", a more restricted meaning, "the branch of a tree." But Wu Ying K'uei (吳應遠) points out that 枝 must not be accepted as the standard form for writing the second half of the word lychee (荔枝), as practically all Chinese authorities on this fruit use the single-radical word 支.

A more thorough study of the Chinese character 荔 should prove of interest. Examination reveals that it is made up of two of the 214 idiographs or radicals of which the Chinese written language

¹ WU YING K'UEI (吳應遠) *Ling Nan Li Chih P'u* (嶺南荔枝譜) in *Ling Nan I Shu* (嶺南遺書), book 59 (第五十九本), section 1 (第一卷), page 1 (第一頁).

consists, namely: 艸 which in the contracted form is written 艹 and means "grass" or "plant" and 刀 which means "knife." We then have at the top of the character 荔 a "plant" and at the bottom "three knives." Wu Ying K'uei points out that these three knives, written 劦, represents "to cut." The sound of this character 荔, pronounced "li", is doubtless a corruption of the sound "lay", associated with the character 離, which was used to represent the fruit before the idea was originated to give it the present "knife and plant" character 荔. It is also worthy of note that Wu Ying K'uei cautions all writers of Chinese to write the word "li" 荔, and not 荔 as so many do. The character 荔 is pronounced "hip", and means "to cooperate" and is foreign to the original idea of using the three knife character 劦, "to cut."

Wu Ying K'uei's (吳應遠) claim for writing the word lychee 荔支 is doubtless well established in so far as its derivation is concerned. But modern usage reveals that the word in Chinese may be correctly written 荔支, 荔支, 荔枝, or 荔枝. Just as to-day in English "through" and "thru" are both good forms with considerable preference for *thru* especially in hand writing, so in Chinese both 荔 and 荔 are considered good forms with decided preference for 荔 in handwriting because of the care required not to cross the strokes in making the knife radical 刀. In fact in hand writing most Chinese writers will unconsciously write 力.

The word lychee 荔支 is thus a combination of idiographs which are used in the derivation of the characters 荔 and 支 and in the pronunciation of their sounds. These characters were meant to convey the idea that the fruit of the lychee must be taken from the tree by means of knives and with twigs attached.

There is as much difficulty in arriving at the correct form for representing the characters (荔支) in English as there is in deciding upon the correct characters in Chinese. In representing the Cantonese sounds of the characters in English *lychee* is the most satisfactory form. The fruit is a South China fruit and should be called by the name given it by Cantonese because they not only grow the fruit but sell it all over the world. The name of the fruit as pronounced in western countries always approximates the Cantonese sound. In China the name is pronounced in many ways according to the local dialect of the place. For example in Fukien *lcli* is one of the local names under which it is known. It is true that the most universal dialect of China is Mandarin, which is the official language

of the country. The Giles dictionary gives the Mandarin spelling as *lichih* which would be unintelligible to the average Chinese dealing in "Chinese nuts" abroad; and to the farmer of South China.

Granted that the sounds to be used in making the name an English word should be the Cantonese ones, it is clear that the spelling should be that of *lychee*, for the simple reason that this invariably suggests the exact sounds of *ly* as in *lying* and *chee* as in *cheese*. Unfortunately various factors have operated to initiate other spellings. The Cantonese standard romanization according to Eitel is *laichi*, which may indicate the proper sounds to a westerner living in Kwangtung but to the average reader of English might be pronounced in many ways, since *lai* is found in *laid* and *laity*; and *chi* is found in *child* and *machine*. If we follow the botanical name, as Mr. Higgins¹ urges in his bulletin, or any other of the many approaches to the Mandarin, we either depart from the South China word or we have the trouble of explaining how the strange-looking word is to be pronounced in English. The botanical name *litchi* requires the silencing of the "t" and then the pronunciation of the two "i's" in different ways. Other writers have given us *lici*, *li-tchi*, *la-tzi*, *litche*, *leachea*, *lichì*, *lychi*, *leechee* and *lichee*. Only the last can rival *lychee*. And the objection to *lichee* is in the fact that *li* as an initial syllable has varying sounds as in *little*, *lithe* and *litre*; but *ly* as an initial syllable is always as in *lying*, *lyceum* and *lyrate*. The word *lychee* will best convey the correct Cantonese sound of the word.

The lungan like the lychee is a two-character word 龍眼, meaning "dragon-eye." The fruit of the lungan is smaller and more rounded than that of the lychee and is said to resemble in appearance the eye of a dragon, from whence it doubtless gets its most common name. If 龍眼 be romanized according to the Cantonese pronunciation the words should be written lung-ngan; but as an "ng" sound appears at the end of the first word and also at the beginning of the second, and as this sound is unusually difficult to pronounce, the word "lungan" is more desirable. Chinese literary works and local dialects record many other names for the lungan. One common name is "uen ngan" (圓眼) meaning "round eye." Other names are "lychee no" (荔枝奴), meaning servant of the lychee, because the fruiting season immediately follows that of the lychee; and "a lychee" (亞荔枝), the "second lychee."

¹ Higgins, J. E., *The Litchi in Hawaii*, Hawaii Agricultural Experiment Station, Bulletin No. 44, pages 3 and 4.

CHAPTER III

CHINESE LITERATURE ON THE LYCHEE

No ancient civilization has produced so many valuable works dealing with agriculture and kindred subjects as the Chinese. These books should receive greater attention in the modern advance of science. The lychee has long been a favorite with artists in China and no fruit has inspired more enthusiastic eulogies by the poets and none other has been made the subject of so many special treatises. No fewer than nine special monographs, a list of which is appended, have been written on this fruit, the most celebrated being that of Ts'ai Hsiang (蔡襄)¹ fig. 1. It is a noteworthy fact that the lychee was the first fruit to be so treated by Chinese writers, as is shown by the fact that Ts'ai Hsiang's monograph was the model that inspired Han Yen-chih (韓彥直) to write the first special treatise on the orange in 1179 A.D., one hundred and twenty years later.

It is not surprising that there is so little reference to the lychee in the earliest Chinese historical documents, as it is distinctly a southern plant and even at the time when Confucius compiled the classics (about B.C. 500) the Chinese dominions did not extend far south of the Yangtze river.

That the lychee flourished in the southern part of China before the time of Christ is evidenced by the fact that in a book by an unknown author, to which Pei Wen Chai (佩文齋)² refers, it is recorded that Wu Ti (武帝) of the Han Dynasty (漢朝), B.C.

¹ TS'AI HSIANG (蔡襄), Li Chih P'u (荔枝譜).

The author has had access to three copies of Ts'ai Hsiang's work: (1) A rubbing, the gift of a Chinese friend, indicating that the work at some future time must have been carved on stone; (2) A copy on silk which has been in the possession of a Chinese family for many generations; and (3) The copy in *Ku Chin Tu Shu Chi Cheng* (古今圖書集成), *Po Wu Hui Pien* (博物彙編) *Ts'ao Muh Tien* (草木典), section 273 (第二百七十三卷), *Li Chih Pu I* (荔枝部) pages 1-5 (第一頁至第五頁).

² PEI WEN CHAI (佩文齋) *Kuang Ch'un Fang P'u* (廣羣芳譜), section 60 (第六十卷), page 4 (第四頁).

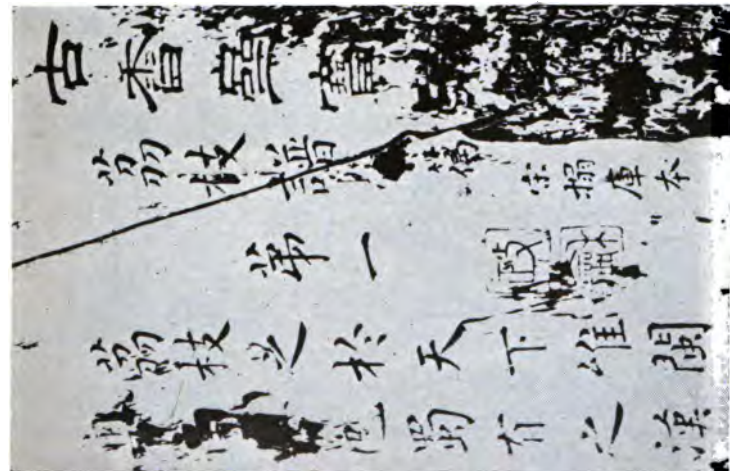


FIGURE 14a.—Reproduction of Ancient Rubbing of Ts'ai Hsiang's "Li Chih P'u."
(Two-fifths natural size.)

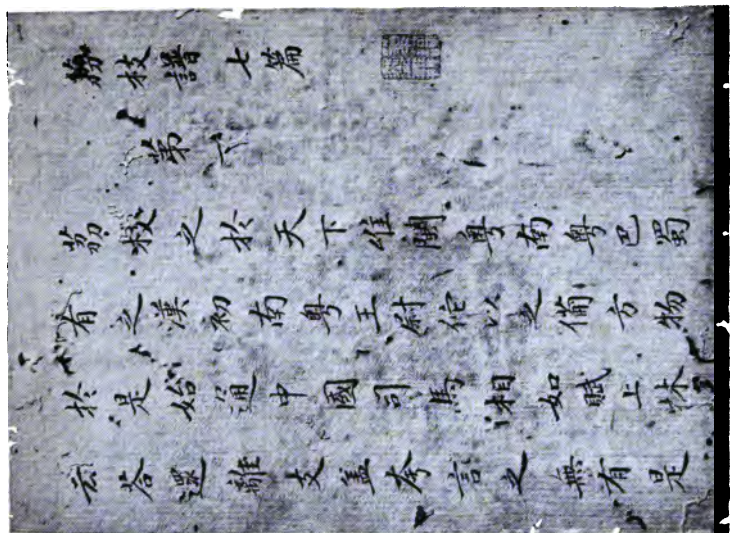


FIGURE 14b.—Reproduction of a Copy of Ts'ai Hsiang's "Li Chih P'u" Written on Silk.
(Two-fifths natural size.)

第二

興化軍風俗園池勝處唯種荔枝當其熟時雖有他
 果不復見省尤重陳紫富室大家歲或不嘗雖別品
 千計不爲滿意陳氏欲采摘必先閉戶隔牆入錢度
 錢與之得者自以爲幸不敢較其直之多少也者列
 陳紫之所長以例衆品其樹晚熟其實廣上而圓下
 大可徑寸有五分香氣清遠色澤鮮紫殼薄而平瓢
 厚而瑩膜如桃花紅核如丁香母剝之凝如水精食
 之消如絳雪其味之至不可得而狀也荔枝以甘爲

FIGURE 1C.—Reproduction of a page of Ts'ai Hsiang's "Li Chih P'u" in the Tsung Li Yaman Reprint of the Chinese Imperial Encyclopedia.
 (Two-thirds natural size.)

140-86, after he had conquered Nan Yueh (南越)¹ and subjected also a part of Annam, built the palace Fu Li (扶荔宮) and in the garden or arboretum appertaining thereto he introduced from the south a hundred or more lychee trees, not one of which grew. This he repeated for several years and finally succeeded in growing one tree which seemed to flourish for a time but never fruited. The Emperor greatly loved this tree but it died after a short period and "several tens" of husbandmen were accused of having neglected it and were killed.

There has been an attempt in Chinese literature to trace the lychee as far back as B.C. 1766. Wu Ying K'uei (吳應遠)² quotes from a work Kuang Yü (廣語) that I Yin (伊尹) of the time of the Emperor Ch'eng T'ang (成湯), B.C. 1766, of the Shang Dynasty (商朝), spoke of a fruit called "feng wan" (風丸) which some people believed to be the lychee.

The great wealth of Chinese literature concerning the lychee, records of which appeared at the beginning of the Christian era and continue to the present day, is a fair indication of the importance of this fruit to the life of the Chinese people. Ts'ai Hsiang (蔡襄)³ records, as translated by Mr. Michael J. Hagerty, "All seven prefectures, such as Tung ching (東京—Tonking and Chia-chih (交趾)—Cochin-China, sent a tribute of fresh lychee to China. In carrying this tribute the couriers adopted the custom of relays, stopping and leaving some of the fresh fruit at improvised depots, some of which were ten "li" apart, while others were but four "li" distant from each other. These couriers galloped quickly, day and night. This enforced tribute oppressed these people like a plague of poisonous insects and wild animals. At Lin-su (臨武) in

¹ Nan Yueh is the old Kingdom of Cochín-China which in A.D. 222 was divided into Chiao-Chou or Tonquin and what is now the area covered by Kwangtung and Kwangsi. See Bretschneider, *Botanicon Sinicum*.—Emil Vasilievich, *Notes on Chinese Botany from Native and Western Sources*, London, 1882, page 23.

² WU YING K'UEI (吳應遠) *Ling Nan Li Chih P'u* (嶺南荔枝譜) in *Ling Nan I Shu* (嶺南遺書), book 59 (第五十九本), section 1 (第一卷) page 1 (第一頁).

³ TS'AI HSIANG (蔡襄), *Li Chih P'u* (荔枝譜) in *Ku Chin Tu Shu Chi Cheng* (古今圖書集成), *Po Wu Hui Pien* (博物彙編), *Ts'ao Muh Tien* (草木典), section 273 (第二百七十三卷), *Li Chih Pu* 1 (荔枝部一), page 2 第二頁.

- Hunan province a man named T'ang Ch'iang (唐光) sent a memorial, protesting against the amount of tribute, and Emperor Ho Ti (和帝), A.D. 89 issued a proclamation ordering his "T'ai Kuan" (太官) or Official in Charge of the Collection of Tribute, to diminish the amount."

As pointed out in the *Ku Chin Tu Shu Chi Cheng* (古今圖書集成),¹ "The Chinese Encyclopedia of Ancient and Modern Times," each of the three great Chinese literary works² dealing with plants refers to the lychee. In the first of these, "Features of Plants in the South," Chi Han (嵇含) includes the lychee among the 80 species described listing it as a fruit tree. In this work he carefully records the characteristics of the tree and fruit and states its yield, all of which agree with the lychee of the present day.

¹ This Compendium of Chinese Literature herein referred to was drawn up and published under Imperial authority in 1726. The botanical section of this gigantic compilation, Ts'ao Muh Tien (草木典), comprises 320 books. See Bretschneider, *Botanicon Sinicum*, pages 71, 72 and note 24.

² a. *Nan Fang Ts'ao Muh Chuang* (南方草木狀).

"This is the earliest Chinese treatise dealing with plants and bear a purely botanical character. The author was Ki Han, a Minister of State under Hui Ti of the Tsin Dynasty (A.D. 290-307). He had been previously governor of Canton. We meet in it interesting accounts of some trees and other plants known at that time in South China, some of them brought from distant foreign countries. The plants are treated under the four classes of herbs, forest trees, fruit trees and bamboos, including in all 80 species." See Bretschneider, *Botanicon Sinicum*, page 38.

b. *Pen Ts'ao Kang Mu* (本草綱目).

"This is the celebrated Chinese Materia Medica written more than 300 years ago and well known in Europe.....It represents indeed the most important native work on Materia Medica and Natural History." See Bretschneider, *Botanicon Sinicum*, page 47.

c. *T'u King Pen Ts'ao* (圖經本草).

This is an illustrated Materia Medica comprising 21 books. It was compiled by Su Sung of Fukien province and published by Imperial Order. See Bretschneider, *Botanicon Sinicum*, page 47.

Chia Ssu Hsieh (賈思勰) of the time of the Northern Wei Dynasty (北魏), A.D. 386-532, in his work on husbandry¹ records that there are many interesting varieties of this fruit, most of which ripen in the fourth month; and that they are preserved by drying, when the flesh and seed do not appear as when fresh.

Tuan Kung Lu (貺公路) of the T'ang Dynasty (唐朝), A.D. 818-904, in his *Geographical Account of Southern China*² records the lycee as a strange and wonderful fruit, the best in South China. He says that it ripens in the beginning of summer and that it has white and transparent flesh with sweet juices; and that it is as large as an egg and some varieties are without seeds. These are only a few of the references quoted in the Chinese Encyclopedia.

Another interesting record is that of Su Shih (蘇軾), high official, poet and essay-writer of the first rank, who in A.D. 1094 was accused of having spoken disrespectfully of the Emperor and was banished first to Waichow (惠州) in Kwangtung (廣東) and afterwards to the Island of Hainan (海南), regions which in those days were utterly barbarous and unknown. These same regions are to-day famous lychee centers and Su Shih (蘇軾) has left us no less than eight poems³ on this wonderful fruit, one of which was composed at the foot of Lo Fou mountain (羅浮山) and has been translated as follows:

“Beneath these green mountains where spring rules the
year

The arbutus and loquat in season appear;

And feasting on lychee—three hundred a day—

I shouldn't mind staying eternally here.”⁴

¹ *T'si Min Yao Shue* (齊民要術).

Bretschneider translates the title of this work: Important Rules for the People to gain their Living in Peace. The original work was in 92 sections but a part of it was lost a long time ago. The edition now current is in ten books. See Bretschneider *Botanicon Sinicum*, pages 77 and 79.

² *Pei hu lu* (北戶錄) by Tuan Kung Lu of the T'ang Dynasty. See Bretschneider, *Botanicon Sinicum*, page 178.

³ *Ku Chin Tu Shu Chi Cheng* (古今圖書集成), *Po Wu Hui Pien* (博物彙編), *Ts'ao Muh Tien* (草木典), section 276 (第二百七十六卷), Li Chih Pu 2 (荔枝部二), pages 5-6 (第五至第六).

⁴ Translation by Mrs. Rose S. Williams.

Of the various Chinese treatises on the lychee, that of Ts'ai Hsiang,¹ A.D. 1059, already quoted, is the earliest and most famous. His work is divided into seven distinct chapters all of which have been translated by Mr. Michael J. Hagerty, of the Office of Crop Physiology and Breeding Investigations of the United States Department of Agriculture. In the first of these chapters he treats of the extent of territory over which the lychee is grown and proclaims his zeal to place this fruit in the position it deserves among the fruits of the world. He had artists draw pictures of the best varieties he had seen and these he classified. In the second chapter he deals with the lychee in his native province, Fukien, and he names one variety, the "Chen family purple lychee" of which he says that though there are a thousand varieties and ten thousand trees, no other one can compare with this. He says of it, "When the Chen family are about to harvest their crop of lychee, they close all their gates or doors and people desiring to purchase the fruit must hand in their money through an aperture in the wall, receiving in return its equivalent in lychee fruit. For that which the purchaser was able to obtain he was thankful and considered himself lucky, never daring to argue whether the price was too much or too little." He then deals with the production and export of the lychee and in the fourth chapter he considers its medicinal properties and speaks of the age of the tree and the excellent character of the wood. He does not fail to discuss the important fact of inability of the lychee to withstand cold and to speak of its chief enemies. In the sixth chapter he deals with a few of the many interesting methods of preserving the fruit which the Chinese used in those days and he tells of the custom of sending the best fruit as tribute to the Emperor. In the last chapter he gives a comprehensive list of the varieties produced and discusses them in some detail.

Sung Chia (宋珏)² of the Ming Dynasty (明朝), A.D. 1368-1627, also wrote a treatise on the lychee in which he quotes Ts'ai Hsiang (蔡襄) and interestingly proclaims his desire to organize

¹ TS'AI HSIANG (蔡襄), Li Chih P'u (荔枝譜) in *Ku Chin Tu Shu Chi Cheng* (古今圖書集成), *Po Wu Hui Pien* (博物彙編), *Ts'ao Muh Tien* (草木典), section 273 (第二百七十三卷), Li Chih Pu 1 (荔枝部一), pages 1-5 第一至第五頁.

² SUNG CHIA (宋珏), Li Chih P'u (荔枝譜) in *Ku Chin Tu Shu Chi Cheng* (古今圖書集成), *Po Wu Hui Pien* (博物彙編), *Ts'ao Muh Tien* (草木典), section 273 (第二百七十三卷), Li Chih Pu 1 (荔枝部一), pages 6-11 第六頁至第十一頁.

a Lychee Society, the purpose of which should be to consume the delicious fruit and to write poems about it. He names twenty-two varieties growing in Kwangtung as recorded by Cheng Hsiung (鄭熊).

One of the most recent treatise on the lychee, and which does not appear in the Chinese Encyclopedia, is that of Wu Ying K'uei (吳應達)¹ published in 1826. This treatise deals with the lychee in the Ling Nan (嶺南) region of Kwangtung (廣東) and has been translated into English by Mr. Hoh Hung Ping (何鴻平) of the Canton Christian College.

The Chih Wu Ming Shih T'u K'ao (植物名實圖考)², an illustrated Chinese botany published in 1848, reprints a number of the well-known lychee monographs and in connection with the illustration of the lychee Wu Ch'i Hsün (吳其濬), the author, writes an interesting essay. In this essay it is recorded that Yü Lo Nung (零陵農) of Fukien province had among his pupils one who later became an official in Yuan Kiang (元江) in Yunnan (雲南). Yu Lo Nung (零陵農), later visited his friend in Yunnan and found recorded in the annals of Yuan Kiang (元江) that the lychee had been produced there. Upon inquiry why this section did not still produce lychee he learned that it was because of the difficulties of communication and the labor and trouble involved in sending lychee tribute to the Emperor. Because of the hardships imposed upon them the people had decided to cut down all the lychee trees. Yu Lo Nung (零陵農) again pointed out that Yuan Kiang (元江) was well adapted for lychee culture and he strongly urged the official to introduce them from Nan Hai (南海) in Kwangtung province. The final answer of his friend was that Yuan Kiang (元江) was hot and damp and that the lychee introduction was not worth the effort as he would not be there for more than three years. He said that, moreover, as this was the only place in Yunnan that could possibly produce the lychee, its production would cause the people much hardship because of the custom of tribute. He remarked, "For one taste of sweetness by the officials, the people are caused much trouble. Ah! How sorry I am!"

¹ WU YING K'UEI (吳應達) *Ling Nan Li Chih P'u* (嶺南荔枝譜) in *Ling Nan I Shu* (嶺南遺書), book 59 (第五十九本), and in six sections (共六卷).

² WU CH'I HSÜN (吳其濬), *Chih Wu Ming Shih T'u K'ao* (植物名實圖考), fruit division (果類), section 31 (第三十一卷), pages 10 and 11 (第十頁至第十一頁).

One of the most helpful sources of information in the study of these fruits has been the provincial, prefectural and district gazetteers or annals. Each political division of China has at regular intervals systematically published these geographical records which contain helpful information regarding history, production and matters of interest in the life of the people. By means of these records it has been possible to determine the districts in which the lychee and lungan are grown and to secure valuable data relative to culture and varieties. The Chinese works consulted include these and miscellaneous works together with the nine standard works on the lychee. A list of these is appended and most of them will be found in the Library of Congress at Washington. These works are constantly referred to throughout the text. They not only record numerous legends regarding these fruits which would enrich a child's book of fairy tales; but they discuss in an enlightening manner the habitat, culture, varieties and trade of these important fruits. Many of the problems involved in the successful culture of these fruits have been discussed by Chinese writers and their records should prove of great value in the development of the industry at home and abroad.

CHAPTER IV

EUROPEAN AND AMERICAN LITERATURE

ON THE

LYCHEE AND LUNGAN

The first unquestionable records regarding China, appearing in the West in the twelfth century, were in Arabic. In these there is apparently no mention of the lychee and lungan. Gonzalez de Mendoza's work in Spanish, published in Rome in 1585, translated into English by R. Parke in 1588, was the first detailed record regarding China published in any European language after the discovery of the sea route to China in the early part of the sixteenth century. As translated by Parke, Gonzalez de Mendoza¹ referred to the lychee in the following words: "Also they haue a kinde of plummies, that they doo call lechias (*Dimocarpus leechee*), that are of an exceeding gallant tast, and neuer hurteth any body. although they shoulde eate a great number of them."

In "De Christiana Expedition"², published in 1615, *Licyas* and *Longanas* are mentioned but Alvaro Semmedo³ in his work published in Italian in 1643, and "put into English by a person of quality" in 1655, describes the fruit more completely. He says, "The Southern provinces have the best fruits of all India; particularly

¹ Gonzalez de Mendoza, Juan, The History of the Great and Mighty Kingdom of China and the Situation Thereof. Translation out of Spanish by R. Parke. London, Printed for the Hakluyt Society, 1588, page 14.

² Trigault, Nicolas, De Christiano expeditio ne apud sinas suscepta ab societate Jesu. Ex P. Matthaei Ricii eiusdem societatis commentariis Libri V. Augusta Vind. Augustburg, 1615, page 10.

³ Semmedo, Alvaro, The history of that great and renowned monarchy of China Lately written in Italian by F. Alvarez Semedo. Now put into English by a person of quality, and illustrated with several mapps and figures. London, Printed by E. Tyler for I. Crook, 1655 page 5.

Cantone; for they have Anans, Manghas.....; and above all, there are some fruits proper to them of a particular excellency, such as in Cantone are the *Licie*, (so the Portughess call them, but the Chineses, *Lici*.) These on the outside are an orange colour, and when they are ripe doe very much beautify the trees they grow on. They are made like chastnuts, in the forme of an heart; when the shell is pilled of, which is only contiguous to it, the fruit remains like a pearl in colour, very pleasing to the sight, but more to the taste."

In 1655 Martinio¹ reported the lychee and lungan from Fukien in the following words as translated by Mrs. Maude Kellerman Swingle: "A quantity of the fruits called Lichi, in Portugese *Machaenses Lichias*, is also found in the eastern part of the Province [Fukien] and especially about the cities; they are borne on large tall trees which have leaves like the laurel and whose top branches produce fruit like bunches of grapes but with fewer fruits and longer peduncles; the fruit is the shape of a heart, and the size of a walnut, resembling a small pine cone, having a scaly but not thick skin for it can be easily broken with the hand alone; inside is the succulent white flesh with a suave rose odor and taste; at maturity the fruit becomes purple so that the trees themselves look purple ornamented all over with hearts, a beautiful sight to delight the eyes; the seed or stone is surrounded by flesh, and the smaller the seed the better and more superior the fruit; rightly may I say that it is the king of fruits; often have I considered how it delights the eye and one never wearies of the taste, its flesh is like sweet meats made of congealed (candied?) roses as the people call it and I have often seen that it almosts melts in the mouth.

"There is also another fruit which is round and has a different skin from the above,—this is called the Lung yen, that is dragon's eye; it is not equal to the above in size but is a little smaller and rounded almost like a cherry. The skin is somewhat harder than that of the "Lichi" and has larger scales. Both are also dried in China and are sent from this province (Fukien) to delight the whole empire, but the dried fruits cannot be compared to the fresh ones as almost all the suave juice is lost. From the "Lichi" also a liquor is expressed, which the Chinese call wine; it is agreeable enough but not often found."

¹ Martinio, Martino, Atlas Sinicus sive Magni Sinarum Imperii Geographica descriptio, auctore R. P. Martino Martinio e Societate Jesu, ex Sinarum regno in Urbem misso Procuratore..... Vienna, 1655, page 123.

In 1656 Michel Boym's work¹ was made known and published later in Melchisedech Thevenot's *Relations de divers voyages*. Boym devoted a paragraph to the *Li-ci* and *Lum-yen* and said that the trees appear only in the southern provinces of China; that the fruit of the *li-ci* somewhat resembles that of the pine and that the *lum-yen* has a very thin skin; that the texture is somewhat like that of the grape and is dried in large quantities by the Chinese. He reported how the Chinese claim that when the fruit is wild it has very large seed, scanty flesh and sub-acid taste, but if it is transplanted and cultivated the seeds soon decrease in size and the flesh becomes sweet and abundant. He likened the color of the flesh to human nails and says that the Chinese sometimes preserve the fruit in salt water and thus are able to maintain its freshness. His drawing of the tree and fruit, carefully labeled with Chinese characters, was probably the first figure of the tree published in the West. Giacomo Zanonii (1615-1682)² also pictured the lychee, showing limb, leaves, fruit and flower. His work not published until 1742. It describes the lychee as a tree of large, thick, oblong leaves; the white flowers occur together; fruit very red with thin skin and white flesh. He says that the kernels of the fruits are sometimes used with flour for making bread and that the poorer ones are made into powder to produce a cooling drink. The pre-Linnean name *Lischion Indiae orientalis* was given by Zanonii. In 1662 Johannes Jonstonus's work³ appeared in Latin. His observations were so similar to those of Boym as to make one feel that the latter was the source of the information. He also devoted a whole plate to a drawing of the tree and fruit which he, too, carefully labeled with Chinese characters.

Dr. Olfert Dapper⁴, Dutch traveller in his work published in Amsterdam in 1670, reports that in Chungkingfu, Szechwan, the lychee grows everywhere in great abundance; and that in south-west

¹ Boym, Michel, in Thevenot, Melchisedech, *Relations de divers voyages*. Paris, A. Pralard, 1683, page 20.

² Zanonii Giacomo, Jacobi Zanonii Rariorum stirpium historia ex parte olim edita Bononiae, ex typographia Laelii a Vulpe, 1742, page 147.

³ Jonstonus, Johannes, *Dendrographias: sive, Historiae naturalis de arboribus* Francofurti ad Moenum, sumptibus haeredum Matthaei Meriani, 1662, page 475 and Tab. cxxxvi.

⁴ Dapper, Olfert, *Gedenkwaardig bedryf der Nederlandsche Oost-Indische maetschappye, op de kuste en in het keizerrijk van Taising of Sina* Jacob van Meurs, Amsterdam, 1670, pages 208 and 209.

Fukien, especially in Hinghwafu, it grows in still greater abundance. He states that the fruit grows on trees with a leaf much like that of laurel; that the fruits form in bunches on the twigs at the tops of the branches, much like the grape, but on longer stems. He says that the fruit has exactly the shape of an animal's heart and so pictures it in his drawing; and that inside the fruit is a juicy flesh, white in color and with the fragrance of a rose. He says that when the tree is in fruit it seems to be decorated with purple hearts and is greatly admired by onlookers. He concludes, "The flesh almost melts like sugar in the mouth, and does not hurt anybody. Rightly may this fruit be called 'Queen of Fruits'."

George Joseph Camell, or Kamel¹, in a work on the herbs and shrubs of the Island of Luzon in the Philippines, published as an appendix to John Ray's *Historia plantarum*, reported local Philippine names as well as the Spanish and Chinese names of what was apparently the Philippine "alapag", *Euphoria cinerea* Radlk. He says that this species grows to about the height of a walnut tree, with alternate leaves much resembling the laurel; flowers white and odorous; fruit small, about the size of a hen's egg with a verrucose membranous skin at first green but turning to red, and dark in color when dry. He describes the fruit as containing a small mouthful of diaphanous, excellent, sweetly acid flavor in which there is an oblong tereate seed. He says it is abundant in the mountains Batan, Paliopican in Zebu, Bohol and Basilan.

Peter J. B. Du Halde², a Jesuit, in a work published at the Hague in 1736, mentions among other fruits the *Tse-tse* (doubtless the Chinese persimmon), *Li-tchi* and the *Long-yuen*, saying that they are peculiar to China where they are highly regarded and that they grow especially in the province of Kwangtung. He says that scarcely any fruit can be compared with the lychee, especially those varieties with small seeds.

¹ Camello, Georgio Josepho, *Herbarum aliarumque stirpium in insula Luzone philippinarum* (Appendix to John Ray's *Historia plantarum*), 1704, pages 53 and 54.

² Du Halde, Jean Baptiste, *Description géographique, historique chronologique, politique, et physique de l'empire de la Chine et de la Tartarie Chinoise*, Tome Second, A La Haye, Henri Scheurleer, 1736, pages 170 and 171.

Pehr Osbeck¹, Rector of Hasloef and Woxtorp, Member of the Academy of Stockholm and of the Society of Upsala, in his *Voyage to China and the East Indies*, interestingly reported in 1757 a certain thrilling experience in his search for plants in which he says, "Near this place was a garden, but neither entreaties nor money could procure me an entrance. . . . We went to the house where the surveyor of it lived. Here was a little gilt figure, on an altar, which was one of the lares of the Chinese. We were well received in his room; and he immediately ordered a dish of tea without sugar, and a tobacco-pipe to be given us but did not desire us to sit down. We were afterwards presented with two sorts of fruit, which in their language are called *La-tyee* and *Longan*." These Osbeck has described in another place as a fruit which is eaten with tea, tasting almost like a sort of our plums and covered with a brownish, thin and warty skin, in appearance something like gall apples. As translated in English he says, "Lang-an is less than lat-ye; they have a smooth skin, and sweet pulp, as in the lat-ye."

The first modern botanical name, *Litchi Chinensis*, was given by Pierre Sonnerat², Commissioner of Marine and Naturalist under royal pension, Correspondent of the Royal Household, and Member of the Royal Societies of Paris and Lyons, in his publication of 1782. Sonnerat gives a careful and complete description of the lychee and says. "Its fruit is very agreeable and one of the best in the country. When it is ripe it is of a russet or reddish color. The Chinese dry it in an oven to keep it and thus prepared it becomes an object of commerce. The Longan of China should be included in the same genus."

Grosier's³ very comprehensive *General Description of China* translated from the French into English and published in 1795, contains the following interesting but somewhat questionable

¹ Osbeck, Peter, *A Voyage to China and the East Indies*. . . . London, B. White, 1771, pages 308, 326 and 327.

² Sonnerat, Pierre, *Voyage aux Indes Orientales et a la Chine*. . . . 2 volumes and plates, Paris, L'auteur, 1782, Tome second, page 230 and plate 129.

³ Grosier, Jean Baptiste Gabriel Alexandre, *A general description of China: containing the topography of the fifteen provinces which comprise this vast empire; that of Tartary, the isles, and other tributary countries.* The second edition, translated from the French of the Abbe Grosier. London. G. G. and J. Robinson, 1795, Vol. 1, page 426 and 427.

statements with regard to the lychee, "We are assured that this fruit is delicious; but it is dangerous when eat to excess; for it is so hot, that it occasions an eruption over the whole body. . . . The li-tchi which are carried to Peking for the use of the Emperor, inclosed in tin vessels, filled with spirits mixed with honey and other ingredients, preserve indeed an appearance of freshness, but they lose much of their favour. That this Prince might taste them in the highest perfection, the trees themselves have been sometimes transported to the capital in boxes; and they have been so well managed, that, when they arrived there the fruit was near its maturity. The other kind of fruit peculiar to the southern provinces is the *long-yen* or dragon's eye; it is of a round figure, has a yellowish skin, and its pulp is white, tart and juicy. It is said that the fruit of this tree is not so agreeable to the taste as the *li-tchi*, but is, however, more wholesome, and may be eaten with great safety." Sir George Leonard Staunton¹ mentions a fruit, the *see-chee* (probably the persimmon) with that of the *lee-chee* in the account of his journey to Canton in 1797 found in his work concerning his embassy to China. He says, "The Chinese want some European fruits, such as gooseberries, currants, raspberries and olives; but abound in others such as the *see-chee*, and the *lee-chee*, which are not produced in Europe. . . . The *lee-chee* is not much bigger than a large cherry, with a skin full of soft prickles. The taste of the pulp is tart; and it covers a kernel, in proportion, large. The *lee-chee* is often preserved, and in that state has somewhat of a sweet taste." Jose Monteiro de Carvalho² in his *Diccionario portuguez* 1817, devoted ten lines to the *Lexia* and says, "Leaves compact and wide of a yellowish, green color. . . . The fruit is somewhat like the shape of a green pear, the which is the most tasty and beautiful that God has created in the Universe."

The beginning of the 19th century witnessed a wider interest in Europe in the culture of these fruits. The *Transactions of the Horticultural Society of London*,³ 1818, contains a report on their introduction into their gardens under the names of *Dimocarpus*

¹ Staunton, Sir George Leonard, An authentic account of an embassy from the King of Great Britain to the Emperor of China. London, G. Nicol, 1797, Vol. 2, page 463.

² Monteiro de Carvalho, Jose, *Diccionario portuguez das plantas, arbustos*. Lisboa, 1817, Tomo 1, page 316.

³ Royal Horticultural society, London, *Transactions of the Horticultural Society of London* volume II, 2d edition, London, 1818, pages 402 and 403.

Litchi and *Dimocarpus Longan*. This is followed with a description of these fruits, with a record of the fruiting of the longan in a "stove" erected by John Knight, Esq., of Lee Castle for the purpose of growing tropical fruits. This report contains a handsome drawing of a bearing twig of these *longans*. It states that these fruits, natives of the southern part of China, have been transferred to different places in the East Indies. Edwards's *Botanical Register*¹ published in London in 1835 deals with the "Longan Tree," under the name of *Euphoria Longan* and states that the lychee and lungan are two of the finest fruits that the Chinese possess. He says, "They have, when imported, a brown shell, which in the former is prickly, in the latter simply warted, and contain a single seed surrounded by a succulent aril, having much the taste of an excellent raisin, only rather more vinous." He says that this species seldom flowers in England and has produced at only one place; namely at Mr. John Knight's. He quotes in full from the Transactions of the Horticultural Society in London and supplements the drawing therein contained by one of a similar twig in flower. Robert Fortune², Botanical Collector to the Horticultural Society of London in the second edition, 1847, of his *Three Years Wanderings in the Northern Provinces of China, including a Visit to the Tea, Silk, and Cotton Countries*, mentions among trees growing over the plains and near the sides of the river, the *leechee* and *longan*. In his chapter on "Native Fruits," he says, "What may be more properly called Chinese fruits, such as the leechees, longans and wangpees; are, however, excellent, the climate suiting them admirably. When I was here [in July], the leechee trees were covered with their fine red fruits, and were very beautiful, the fruit contrasted so well with the deep clear green foliage....."

Alphonso de Candolle³ in his *Origin of Cultivated Plants*, second edition, 1886, deals with the *litchi*, *longan* and *rambutan* all under the generic name of *Nephelium*. He says that it does not

¹ Edwards's *Botanical Register*; or ornamental flower-garden and shrubbery, New Series, Vol. 7. London: James Ridgway and Sons, Piccadilly, 1835, No. 1729.

² Fortune, Robert, *Three years wanderings in the northern provinces of China, including a visit to the tea, silk, and cotton countries with an account of the agriculture and horticulture of the Chinese, new plants, etc.* Second Edition. London: John Murray, 1847, page 384.

³ Candolle, Alphonse Louis Pierre Pyramus de, *Origin of cultivated plants*, Second edition, London, Kegan Paul, Trench & Co., 1, Paternoster Square, 1886, pages 314, 315 and 316.

seem that any botanist has found the lychee in a truly wild state probably because the southern part of China towards Siam has been little visited. George Watt¹ in his *Dictionary of economic products of India*, 1891, also considers these fruits under *Nephelium*. He speaks of its success in India, especially Bengal and he quotes Dr. Bonavia's enthusiastic remarks in the *Pioneer*.

All the literature on the lichee in the United States is very recent. One of the first references is in an article by Prof. C. C. Georgeson² in which he notes that the lychee has been introduced into the extreme south of Japan, but that it does not readily adapt itself to climates differing much to that peculiar to its native habitat, southern China and the Malay Archipelago. A full size illustration of the leaf and fruit is given under the name *Nephelium* or *Litchi-Nut*. "Nut Culture in the United States," a United States Department of Agriculture publication by W. P. Corsa³ includes the lychee fruit as an introduced species under the name *Leechee* (*Nephelium litchi* Cambess) as it also does the *Rambutan* (*Nephelium lappaceum*). It speaks of the lychee as a product generally on sale at Chinese shops in different cities and often called Chinese nut. An interesting and important account of its frost resisting qualities is given and the statement made that specimens of this fruit, grown in Florida, were on exhibit at the Rose and Strawberry Show of the Massachusetts Horticultural Society, June 26, 1883.

The *Pharmaceutical Review*⁴ of 1897 mentions under Sapindaceae three of the important fruits of this family. It records under "Longan" that the fruits are cultivated in Cuba from China and that they have a winy taste and are refrigerant; that "Rambustan"

¹ Watt, George, A dictionary of economic products of India, Calcutta, printed by the Superintendent of Government printing, 1889-1893, 6 volumes. Vol. 5, pages 346 and 347.

² Georgeson, C. C., The economic plants of Japan in the *AMERICAN GARDEN*, an illustrated journal of horticulture, Vol. 12, No. 3, March, 1891, pages 269 and 270.

³ Corsa, W. P., Nut culture in the United States, embracing native and introduced species. Washington, Government printing office, 1896, page 105.

⁴ *Pharmaceutical Review*, formerly *Pharmaceutische Rundschau*. Pharmaceutical Review Publishing Company, Milwaukee, 1897, Vol. 15, pages 89 and 90.

are pulpy, sweet and edible, seeds narcotic, bitter; and that the fruit of "Litchi" is sweet, rather acid, refrigerant and pectoral and used to make refreshing adjuvant drinks in treating slow fevers.

F. W. Popenoe¹, in the 1917 Edition of L. H. Bailey's *Standard Cyclopaedia of Horticulture*, outlines the culture of the lychee, under "Litchi." He deals with the *rambutan*, *pulassan* and *longan* under *Nephelium*. At the time this work goes to press the Macmillan Company has in preparation a work by Wilson Popenoe on Tropical and Sub-Tropical Fruits, and among the hundred or more fruits discussed is the "Chinese litchi."

In the years 1915 and 1916 considerable interest in the lychee seems to have been manifested in Florida. A paper was read before the State Horticultural Society by W. S. Taylor² who also wrote articles for the Florida Times Union in an endeavor to arouse the people of his state to an interest in this fruit.

The Hawaii Agricultural Experiment Station issued a bulletin July 27, 1917, "The Litchi in Hawaii" by J. E. Higgins³, Horticulturist. This work contains valuable information regarding some interesting experiments in propagation which were performed at that station and also with regard to insect enemies. This work has been a valuable contribution to the increasing interest which is now manifested in the lychee and lungan and it is frequently referred to in the body of this work.

¹ Popenoe, F. W., in The standard cyclopedia of horticulture, edited by L. H. Bailey, in six volumes, New York, The Macmillan Company, 1917, Vol. 4, pages 1891, 1892, 1893 and 2131.

² Taylor, W. S., Florida grower, July 17, 1915, and April 18, 1916; Florida times union, February 8 and 22 and March 2, 16 and 23, 1916.

³ Higgins, J. E. The Litchi in Hawaii, Hawaii Agricultural Experiment Station, Bulletin No. 44, Washington, Government printing office, 1917.

CHAPTER V

BOTANY OF FOUR IMPORTANT SAPINDACEOUS FRUITS

The sub-family Nephelieae of the family Sapindaceae has for centuries provided the thickly populated regions of Southern Asia and the East Indies with four popular and refreshing fruits. These represent four distinct species which are grouped within three closely related genera, one each in *Litchi* and *Euphoria* and two in *Nephelium*. Each species is represented by a number of horticultural varieties which have been popularized by the inhabitants of the regions in which the fruits are grown. It is surprising that not one of these four fruits has ever been commercially introduced into the Western Hemisphere and that there is not found there a single cultivated fruit belonging to this family. The four fruits herein described should prove worthy introductions into any country where climate and soil are adapted to their culture.

Of the four fruits of this study the lychee is doubtless the most widely known in foreign countries. As the dried, so-called "lychee nut" it is exported from China in considerable quantities. Foreign residents of southern China, and visitors who come here in the summer, always remember the lychee as the one distinctive fruit of this region. At no other place in the world, except to some extent in India, is the lychee grown as a commercial fruit. In China, in the provinces of Fukien and Kwangtung, the cultivation of the two sub-tropical species has developed into one of the largest fruit industries of the nation.

The family Sapindaceae includes among its species the common soapberry¹ and a large number of tropical and sub-tropical trees,

¹ The family *Sapindaceae* is commonly known as the soapberry family and includes the genus *Sapindus*. This name is said to be a contraction of *Sapo Indicus*, *Indian soap*, which has reference to the saponaceous character of the berries. The species found common in United States is *S. acuminatus* Raf. A very common species in China is *S. mukorosi* Gaertn. commonly known as Mu Huan (木患) or Wu Huan Tsu (無患子) and widely used for soap. Herbert A. Giles in his Chinese-English Dictionary, page 632, says that the black seeds of this species are used as charms to drive away demons and their pulpy skin as a detergent.

some of which bear edible fruit. The *lychee* and the *lungan* are the two most important sub-tropical forms and the *rambutan* and the *pulassan* are the two most highly developed tropical species. Formerly these four were usually grouped in the genus *Nephelium* with the names *N. litchi*, *N. longana*, *N. lappaceum* and *N. mutabile* respectively. George Don (1831-1838)¹, Miquel (1855-1859)² Hooker (1875)³, and Kurz (1877)⁴ give excellent outlines of *Nephelium* under which they list the *lychee* and the *lungan*. Baillon⁵ in his work published in 1878, divides the *Sapindaceae* into eight series with 74 genera. His third series, *Sapindeae*, with 40 genera includes the plants of this study. Recent botanists have placed the *lychee* and the *lungan*, according to characters which readily separate them from the *rambutan* and the *pulassan* and from each other, in the two separate genera *Litchi* and *Euphoria*. They continue to group the *rambutan* and the *pulassan* under *Nephelium*. Radlkofer⁶ who has given the group the latest and best study has also followed this treatment.

It is fortunate that this family of plants has been the life-long study of the botanist, Ludwig Radlkofer, to whom we now look as the authority on the relationships of the *lychee* and the *lungan*. It is difficult to over-estimate the value of the kind of knowledge such as Radlkofer has collected and recorded in his numerous writings on the *Sapindaceae*. In experimenting with stocks on which to graft the *lychee* and also in hybridizing work, such knowledge is absolutely indispensable. As a result of Radlkofer's careful investigations, the relationships of the *lychee* and the *lungan* to the other members of

¹ Don, George, *A general history of the dichlamydous plants*. In four volumes. London, J. G. and F. Rivington. 1831. Vol. I, pages 654, 655, 670 and 671.

² Miquel, Friedrich Anton Wilhelm, *Flora van Nederlandsch. Indie*, Amsterdam, C. G. van der Post, 1859, pages 554, 555, 556 and 557.

³ Hooker, Sir Joseph Dalton, *Flora of British India*. London, L. Reeve & Co., 1875. 7 vol. Vol. I pages 686, 687, 688, 689 and 690.

⁴ Kurz, Sulpiz, *Forest flora of British Burma*. Calcutta, Office of the superintendent of government printing, 1877. 2 volumes. Vol. 1, pages 292-293 and 294.

⁵ Baillon, Henri Ernest, *The natural history of plants*, London, 1878, L. Reeve & Co., in 8 volumes. Vol. 5, pages 350, 377, 394, 395 and 396.

⁶ Radlkofer, Ludwig, *Sapindaceae in die natürlichen Pflanzenfamilien*, begr. von A. Engler und K. Prantl. Leipzig, Verlag von Wilhelm Engelmann, 1896. III Teil. 5. Abteilung, pages 328 to 334.

the family are known with a high degree of probability. For example we find the species most closely related to the lychee, *Litchi chinensis* Sonn. and hence of greatest promise for use as stock, is the Philippine wild lychee, *Litchi philippinensis* Radlk. (fig. 2), a large tree reaching a considerable height and growing on the hills and mountains at an altitude of 100-1700 feet. *Pseudonephelium fumatum* (Bl.) Radlk. is also very closely related and may serve as a useful stock on which to grow the lychee. Considerable experimentation along this line has already been done with *Euphoria longana* Lam., to which the Philippine form, *Euphoria cinerica* Radlk. (fig. 3) is closely related.

Radlkofer places the four fruits in the subfamily *Nepheliaceae* which he divides into 12 genera with about 78 species. These he classifies under two main divisions. The one, which includes the four species widely cultivated for their edible arils, has indehiscent fruits and is limited to tropical and sub-tropical Asia and the northern islands of the Malayan Archipelago. The other, which includes the Titoki tree of New Zealand, has fruits opening spontaneously at maturity and occurs in Polynesia, Australasia, the southern islands of the Malayan Archipelago and in South Africa. No species of the latter is known to occur on the Asiatic mainland or on the neighboring islands. The first of these groups, with fruits not opening spontaneously at maturity, is divided by Radlkofer into two sub-groups. The one, which includes the lychee and the lungan, has fruits with the arillus free from the seed. The other, which includes the rambutan and the pulassan, has fruits with the arillus adherent to the seed. This subfamily *Nepheliaceae*, with special reference to the four fruits with which we are concerned, can thus be represented as follows:

I—Fruits indehiscent

A—Fruits with arillus free from the seed

1—The LYCHEE GROUP comprising the genera *Litchi* and *Euphoria*, and two others, with a total of 15 species (see outline of Lychee Group).

a—Leaflets with lateral veins obsolete. Calyx 1/5 cleft; petals none. Fruit muricate and red. *Litchi chinensis* Sonn. (fig. 44), the lychee of commerce.



FIGURE 2.—Herbarium Specimen of *Litchi philippinensis* Radlk.
(One-half natural size.)



FIGURE 3.—Herbarium Specimen of *Euphoria cinerea* Radlk.
(One-half natural size.)



FIGURE 4.—Root System of a Mature Lychee Tree.



FIGURE 5.—A Flower Panicle of the Lychee.

aa—Leaflets with lateral veins more or less conspicuous. Calyx $1/2$ cleft; petals five. Fruit smaller than above, smooth and yellow. *Euphoria longana* Lam., (fig. 59), the lungan of commerce.

B.—Fruits with arillus adherent to the seed

2—The RAMBUTAN GROUP comprising the genus *Nephelium* and two other genera, including in all about 35 species.

a—Leaflets 2-12. Fruit echinate-muricate with long, hairy setae, $1/2$ to 2 in. long; red, yellowish, orange or nearly black. *Nephelium lappaceum* Linn., the rambutan.

aa—Leaflets 4-8. Fruit echinate-muricate with strong, rigid setae, 1 to $1\frac{1}{2}$ in. long; red; aril separates more readily from the seed than in the former. *Nephelium mutabile* Blume, the pulassan.

II—Fruits dehiscent

3—The TITOKI GROUP with 5 genera including in all about 28 species.

Of the three groups above represented, the lychee group is of the most importance inasmuch as it contains the species most commonly represented in China and the Philippines and especially as it contains the two most highly prized and commercially developed of the four fruits. The titoki group is of no special significance in this study.

THE LYCHEE GROUP

Litchi chinensis Sonn. • Voy. p. 230. (1782)

Litchi philippinesis Radlk. in Philip. Journ. Sci. 8 (C, 6): 458. (1913)

Otonephelium stipulaceum Radlk. in Engl. & Prantl. Natl. Pfl.-fam., 3.V:329. (1895)

Nephelium stipulaceum Bedd. in Madras Journ. ser. 3, no. 1. p. 39. (1864)

Pseudonephelium fumatum Radlk. in Engl. & Prant. Natl. Pfl.-fam., 3.V:329. (1895)

- Nephelium fumatum* Blume, Rumphia, 3:111. (1847)
- Euphoria longana* Lam., Encycl. meth. 3:574. (1791)
- Euphoria cinerea* Radlk., Sitzb. Akad. Wiss. Münch. 8:299. (1878)
- Sapindus cinereus* Turcz., Bul. Soc. Nat. Moscow, 31:402. (1858)
- Euphoria stellulata* Radlk., Sitzb. Akad. Wiss. Münch. 8:303. (1878)
- Sapindus stellulatus* Turcz., Bul. Soc. Nat. Moscow, 31:403. (1858)
- Euphoria elongata* Radlk., Sap. Holl.-Ind. in Actes Congr. Bot. Intern. Amsterdam. (Separate with new pagination) p. 7, 25. (1877 or 78?)
- Euphoria mataiensis* Radlk., Sap. Holl.-Ind. in Actes Congr. Bot. Intern. Amsterdam. (Separate with new pagination) p. 7, 72. (1877 or 78?)
- Euphoria Gardneri* Bedd., Ic. Pl. Ind. Or. p. 67, pl. 285. (1874).
- Nephelium Gardneri* Thwaites, Enum. Pl. Zeyl. p. 58. 1864 (N.B. The transfer in Benth. & Hook. 1867, p. 406 is not a valid tsf.)
- Euphoria echinulata* Radlk., Rec. Bot. Surv. Ind. 3:347. (1907).
- Euphoria setosa* Radlk., Rec. Bot. Surv. Ind. 3:347. (1907).
- Euphoria nephelioides* Radlk., Phil. Journ. Sci. 8 (C, 6): 457. (1913).
- Euphoria foveolata* Radlk., Phil. Journ. Sci. 8 (C, 6): 457. (1913).
- Euphoria gracilis* Radlk. in Elm. Leaflets Bot. 5:1606. (1913).

Note: In cases of transfer the citation is given to the first description as well as to the transfer, and the former is underlined.

BOTANY OF THE LYCHEE

Synonymy of *Litchi chinensis*:

Laetji chinensis Osb. Itin. (1765)

Litchi chinensis Sonn. Voy. p. 230. (1782) pl. 129

Scytalia chinensis Gaertn. de fruct. p. 197, (1785) pl. xlii

Sapindus edulis Aiton. Hort. Kew. 2:36. (1789)

Dimocarpus Litchi Lour. Fl. Coch. (1790) (See ed. 2, p. 286-7)

Euphoria punicea Lam. Encycl. meth. 3:573. (1791)

Euphoria sinensis Gmel. Linn. Syst. Nat. ed. 13 (1796), 2:611.

Euphoria Litchi Desf. D. C. Prod. 1:611. (1824)
(Or Desf. Cat. 159, 1815?)

Nephelium Lit-chi Camb. in Mem. Mus. Par. 18:30. (1829)

Scytalia Litchi Roxb. Fl. Ind. 2:269. (1832)

Nephelium duriocarpus Anders. Fl. Behar, Asiat. Soc. Beng. 32:199. (See Hook. Fl. Brit. Ind. 688)

DESCRIPTION

The tree as seen in cultivation (fig. 6) is a handsome evergreen, 30-50 feet high with a naturally low head 15-30 feet broad and a short stocky trunk, which when mature reaches a diameter of 3-4 feet. Seedling trees in the wild or semi-cultivation usually have a higher trunk and sometimes reach immense dimensions. In the hilly country of South China where trees have ideal growing conditions we have observed lychee trees 70 feet high, with a spread of head of 60 feet and a trunk girth, breast high, of 12 feet (figures 47 and 48). There are numerous, crooked, low-hanging or spreading branches. The tree is glabrous in all its parts and has a smooth bark. The wood is brownish-red, heavy, and close grained and takes a fine polish. In Kwangtung it is commonly used for plow handles and for grain-mill parts. Roxburgh¹ says, "Independently

¹ Roxburgh, William, *Flora Indica; or descriptions of Indian plants*, Serampore, printed for W. Thacker & Co., Calcutta, 1832. 2 volumes. Vol. 2, page 270.

of the well known fruit of this tree, it is highly ornamental, being one of the most permanent evergreens we have in India." It certainly provides a marked feature of much of the beautiful Kwangtung landscape.

The *roots* are fibrous, extending in all directions to about the width of the tree and providing a thick net-work of growth (fig. 4).

The *foliage* for the greater part of the year is of a deep green, laurel-like appearance. In winter or spring the new growth flushes forth a beautiful orange foliage (Ridgeway, Plate II, 90 R-O Mars Orange), which forms quite a contrast in the appearance of the tree. The *leaves* are compound, 3-9 inches long, petioled and abruptly pinnate. In general appearance the Chinese often compare them to those of the camphor and cinnamon trees. *Leaflets* 2-10 (mostly 5, 6 and 7) usually opposite, shortly petioled, oblong or oblong-lanceolate, entire, coriaceous, tapering to a fine point, base cuneate. They are very smooth and glossy above, glaucous beneath and of a firm texture, with netted veins, the lateral ones almost obsolete.

Flowers small and numerous, forming a large, oblong, terminal and leafless panicle (fig. 5) of the length of the leaves or longer. These are ramous and erect or ascending. The small greenish-white or yellowish flowers, 1/12 to 1/8 inch wide are on some trees mostly hermaphrodite while on others mostly male. They quickly turn brown and are not of a pleasing odor. They open in China in March and April, and in Bengal and British Burma in February and March. *Calyx* small, cup-shaped, four, rarely five toothed and both sides downy. *Petals* none. In both the hermaphrodite and male flowers there is a large fleshy, crenulate gland, the *nectary*, into which the stamens and pistil are inserted. *Stamens* from 6-10. *Filaments* in the hermaphrodite flowers short, pubescent and spreading and in the male flower almost three times as long. *Anthems* shorter than filaments, roundish and two-lobed. *Ovary* superior, elevated on a short column, two-lobed, pubescent, two-celled, each containing a single ovule. *Style* erect, rather short and hairy. *Stigma* two cleft, divisions revolute.

Fruit 1-2 lobed, the lobes usually solitary by abortion; very rarely paired. They are round or oval about 1 to 1½ inches in diameter with a thin, leathery, bright red mucicated pericarp which becomes quite brittle when dried. Next under it is the edible

portion which is the delicious, sub-acid, semi-transparent, jelly-like aril which covers the seed. This aril is usually of an azure white or light yellow appearance which in some varieties inclines to a pink. The seed is single, oblong, smooth and brown and loosely affixed at the base to the pulpy aril. It is rudimentary in some varieties, when the Chinese speak of it as like a chicken tongue, and quite large in others. The *embryo* is erect without perisperm,

The lychee might be described a little more fully as a fruit which in size is about that of a very large strawberry or of a small English walnut; it inclines a little more to the elliptical of the strawberry than to the oval of the walnut. When the fruit is fresh the skin has the toughness of a thick-skinned grape but when dried snaps open with the brittleness of a very thin, paper-shelled almond. The skin is leathery and of various textures and always tends toward a verrucose surface with angular tubercles.

The different types vary in color from that of a highly tinted strawberry to the greener tint of a plum. The fruits form somewhat in clusters, but are not bunched as in the grape. When fresh the lychee breaks open and is eaten much like the grape. The flavor and texture of the lychee might be described as midway between the juicy sweetness of a highly cultivated grape and the sub-acidity of a cherry. Some varieties are noted for their delicate, rose-scented fragrance. In the dried form the fruit suggests somewhat the taste and character of a large dried raisin from which the paper-shelled covering must first be removed. In this form some have compared its taste to that of a large dried cherry or grape.

The usual *habitat* of the cultivated lychee is on the foothills or along the banks or dykes of streams of sub-tropical regions. Although its precise indigenous stations have not been ascertained it is doubtless native to South China and grows especially well in Kwangtung and Fukien. A sour, hardy variety, known as the "mountain lychee" or "shan chih" (山支) is found in a semi-wild state in Kwangtung. The lychee is also found in Kwangsi and Szechwan, and in Hongkong, Formosa and Hainan. Introduced from South China it is now widely cultivated in India, especially in the Bengal region and in British Burma. The lychee in cultivation, at its best, is a low-altitude, water-loving plant, especially valuable for planting along the dykes of streams in sub-tropical areas where heavy frosts do not occur.

BOTANY OF THE LUNGAN

Synonymy of *Euphoria longana* as outlined by Karl Ludwig Blume¹:

Nephelium Long-yan Blume.

Nephelium Longana Camb. in Mem. Mus. d'hist. Nat. XVIII, p. 50.

Nephelium Longana Hook. in Curt. Bot. Mag. tab. 4096.-Walp. Repert. bot. V. p. 564. 1.

Nephelium Longanum Wight et Arn. Prodr. Flor. Penins. Ind. Or. p. 115.1. Walp. Repert. bot. 1. p. 420. 4.

Nephelium Bengalense G. Don in Mill. bot. et gard. Dict. 1. p. 670.

Scytalia Longan Roxb., Flor. Ind. II. p. 270.

Bima Noronh. in Verh. Batav. Gen. V. (1790). *Bima cinnamomea* s. Linking M. S.

Dimocarpus Longan Lour. Flor. Cochinch. (ed. Willd.) p. 288.2.-Ait. Hort. Kew. (ed. 2). p. 554.2. Trans. Hort. Soc. II. tab. 28.

Euphoria Longan Lam., Enc. bot. III. p. 574.2.-De Cand. Prodr. Syst. Veg. I. p. 611. 2.

Euphoria Lon-gan Juss. Gen. Plant. p. 248.-Spr. Syst. Veg. II. p. 222.2.-Lindl. Bot. Reg. tab. 1729.

Longannes vulgo Longanier Buchoz Icon. col. tab. 99.

Long-yen Hist. des Voyag. VI. p. 457.

Laeng-an Osb. Itin. (ed. Germ.) p. 251.

Rjutan, v. *Djugan*, vulgo *Djugan* Kaempf. Amoenit. exol. p. 817.

¹ Blume, Karl Ludwig, *Rumphia*; sive, Commentationes botanicae imprimis de plantis Indiae Orientalis, tum penitus incognitis tum quae in libris Rhedii, Rumphii, Roxburghii, Wallichii aliorumque recensentur. Scripsit C. L. Blume cognomine Rumphius.....Lugduni Batavorum, prostat Amstelodami, apud C. G. Sulpke; 1835-48. 4 volumes. Tomus Tertius, page 108.

Lungyen of Dracks-ooge (oculus Draconis) Dapper
Beschr. Sin. p. 209.

Lumyen Jonst. Dendr. p. 475.

Lumyen Boym. in Flor. Sinens.

Long yan v. *Long yen*, vulgo *Lung yen*, et pronunciatione
Japonica Riu gan., i.e. oculus Draconis.

Note: *Euphoria Litchi* (haud Juss!) Blanc. Flor. Filip. p. 285
and *Boa* s. *Boboa*, Boasbas Camell. in Raj. Hist. Plant. III in
App. p. 52. 14 have been eliminated from this synonymy
inasmuch as they do not belong here.

Radlkofer places this species under *Euphoria* and as such gives it the name *Euphoria longana* from Lamarack, *Encyclopedia Methodique* 3:574 published in 1791. As outlined under the lychee group there are ten other species in this genus of which *Euphoria cinerea* (fig. 3), a Philippine form, is especially worthy of closer study. This species is an edible form closely allied to the lungan and known in the Philippines as the "alupag."

This fact that there are in addition to the Chinese lungan other edible species with which to hybridize it, makes the field for the creation of new forms of this hardier species a very promising one. The possibilities of using these forms as stock on which to graft the lychee, as well as the possibilities of hybridizing, make imperative a systematic study and careful collection of all these interesting species.

DESCRIPTION

The tree of the lungan, at its best, is a somewhat more handsome ornamental with higher head and spreading branches. The bark of the tree is decidedly corky instead of smooth as in the case of the lychee. The branches seem more brittle but the wood is not so hard or highly prized by the Chinese as in the case of the lychee.

The *foliage* is usually of a darker green than is that of most varieties of the lychee. In early winter it flushes forth a beautiful garnet brown young growth (Ridgeway, Plate 1, 3 O. R. Garnet Brown) which at once is a distinguishing characteristic from the orange flush of the lychee (Ridgeway, Plate 11, 9 OROO Mars Orange). The *leaves* are compound, alternate, petioled and pinnate.

They average 4-8 inches long. The *leaflets* which are opposite or alternate are of a more oval oblong outline than the lanceolate of the lychee; and their point is less sharp. Unlike the lychee the margin of the leaflets is decidedly wavy. The lateral veins are numerous and unlike the lychee are very prominent. The leaflets are smooth on top and tarnished or somewhat pubescent underneath.

The *flowers* are small but larger than the lychee and arranged on velvety, slightly angular flower stalks. Flowers yellowish-brown. The calyx is hairy outside and divided into five parts. *Petals* five, rarely six; pubescent. Filaments pubescent; anthers glabrous. The ovary is divided into two, sometime three, parts. The lobes are quite large, rounded and velvety. The *style* is thick and *stigma* short and somewhat double. The fruits are rounded, of a yellow brown color and almost smooth on the surface. The flavor of the fruit is not so delicate as the lychee but more vinous. The seed is rounded, of a beautiful black color and marked at the base with a white orbicular spot which gives it the appearance of an eye, giving it the name "dragon eye."

In South China there are many varieties of the lungan, the cultivated forms being usually grafted. The lungan is not only valuable as a fruit tree but is a beautiful ornamental, especially in the winter when it flushes forth its beautiful garnet brown young foliage.

The lungan is a native to South China and is found growing at higher latitudes and higher altitudes than the lychee. It thrives much better on higher ground than the lychee and endures more frost. It is rarely found growing along the dykes of streams as is the lychee but does especially well on high ground near ponds.

THE LUNGLY (龍荔)—A *Lungan-lychee* hybrid

Various Chinese writers refer to what is apparently a hybrid between the lungan and the lychee, and which they call the *lungly*. In the Annals of Kwangsi¹ attention is called to this fruit, where it is said that the lungly tree and leaf have some of the characteristics of both the lungan and the lychee. The pericarp is said to be like the lychee but the meat like the lungan. They are not considered good but can be eaten after cooking. When eaten raw they are said to produce great quantities of mucus in the throat which produces a sickness in the eater. They bear fruit at the time of the lychee.

¹ Kwangsi Tung Chih (廣西通志) by Chi Ching (吉慶), 1800, Volume 29 (二十九本), section 87 (八十七卷), page 7 (第七頁).

TWO FRUITS OF THE RAMBUTAN GROUP

The two fruits of the rambutan group are distinct from the two of the lychee group in that they are tropical instead of subtropical forms and that the arillus is adherent instead of free from the seed. Chinese living in the Straits Settlements report that these two tropical fruits consist of many varieties but that none are so delicious as the lychee. Their chief criticism of these fruits is that the aril adheres more tightly to the seed and that there is a large quantity of rag which cannot be swallowed.

Botanical descriptions of the *rambutan*, *Nephelium lappaceum* Linn., and the *pulassan*, *Nephelium mutabile* Blume, are not attempted here. W. P. Hiern¹ in Hooker's *Flora of British India* gives complete botanical descriptions. Bertha Hoola van Nooten² has pictured the fruit, flowers and leaves of the rambutan on a full page plate. The rambutan is pictured with long, hairy setae. The pulassan is said to have strong, rigid setae. This fact is interesting in view of the rudimentary marks of setae on the lychee and the complete absence in the lungan.

¹ Hiern, W. P., in Hooker, Sir Joseph Dalton, *The Flora of British India*, assisted by various botanists. London, L. Reeve & Co., 1875, 7 volumes. Vol. 1, pages 687 and 688.

² Nooten, Madam Berthe Hoola Van, *Fleurs, fruits et feuillages choisis de la flore et de la pomone de l'île de Java; peints d'après nature par Madame Berthe Hoola van Nooten*. Bruxelles, E. Tarlier, 1863. Issued in 10 parts in French and English.

CHAPTER VI

THE SOUTH CHINA REGION, THE HOME OF THE LYCHEE AND LUNGAN

The South China region, as usually considered, comprises six of the provinces of China, with a total area of 475,000 square miles and a population of 92,000,000. There is grown in this region a wide range of grain, vegetables and fruit. The lychee is decidedly the most popular fruit of the whole section. But it cannot be successfully grown in some of these provinces, only partially so in others, and extensively in but two, Kwangtung (廣東) and Fukien (福建). A few districts of Kwangsi (廣西) produce the lychee but not in great quantities. Chinese literature points to the fact that in Yunnan (雲南) it has been successfully grown in only one district. Szechwan (四川) to the northwest, and geographically not included in the provinces of South China, produces an inferior type. In Cochin-China to the south, now a French possession, the fruit is known to do well and it will grow as far south as Siam. It is also produced in Formosa, the island belonging to Japan off the coast of Fukien province and it thrives exceedingly well in Hainan, the island belonging to China off her south-east coast. The lungan, not so highly prized as the lychee, is nevertheless usually found contiguous to it.

Kwangtung and Fukien are the two great lychee and lungan provinces. They cover an area of 150,000 square miles and they support a population of 55,000,000. Cantonese and Fukienses greatly prize the lychee and have consequently highly developed it. A study of the history and literature of these two provinces interestingly discloses that for centuries these people have striven with one another for supremacy in lychee culture and in the export trade. It is a fact worthy of note that in both these provinces the districts which have been most successful are those which, at low altitudes, lie close to the rivers and coast. The world-wide distribution of these fruits in dried and canned form is accounted for by the fact that these districts are those from which have come most of the Chinese emigrants.

PLATE VII



FIGURE 6.—Rice Field with Lychee Trees along Inner and Outer Dykes.



FIGURE 7.—Limb of Lychee Tree over Lotus Pond.

PLATE VIII



FIGURE 8.—Cantonese Women Harvesting Sagittaria in Muddy Field Bordered with Lychee.



FIGURE 9.—Fish-Ponds along the Pearl River Bordered with Lychee.

PLATE IX



FIGURE 10.—Lychee Trees along Walled Dykes of Pearl River.



FIGURE 11.—Lychee Trees Withstand the Pearl River in Flood.



FIGURE 12.—Attractive Walk along Lychee Dykes.



FIGURE 13.—Lychee and Plum Planted across Dyked Fields.

It is thus seen that although the lychee may thrive best in only specially favored delta regions, its culture is nevertheless possible over a decidedly wide range of sub-tropical territory. The writer is best acquainted with the Canton delta and has described and pictured it as ideal for lychee culture.

The Canton delta is the most densely populated and intensively cultivated region in the world and here the lychee is found in its most varied and highly cultivated forms. Its culture has developed into an industry and whole villages give themselves over almost entirely to its propagation, cultivation and drying. The delta, sometimes called the delta of the Pearl river is a sub-tropical region. It has been formed by the deposits of the North, West and East rivers, which for centuries have deposited their burdens of mud and silt over this area, as they break into numerous creeks and canals before they finally flow out into the South China sea. When these rivers are high, and the ocean tide holds back their waters, the whole area is subject to devastating floods which the lychee, unlike many other trees, very successfully resists. The fields and homes of the delta are protected by numerous dykes which are often held in place by extensive plantations of the lychee. Both outer and inner dykes are constructed and the area between, termed in Cantonese a "wai" (圍), which cannot be drained except when the tide is very low, is used for rice (fig. 6), water chestnuts, lotus (fig. 7) or sagitaria (fig. 8). In fallow years it is filled with water and stocked with young fish (fig. 9) which increase fertility and which are later sold at a great profit if floods have not carried them away.

The outer dykes are often held in place by stone reinforcement and by lychee trees (fig. 10), the roots of which are shallow feeders and help to bind the earth. They are thus able to withstand floods of great force, some conception of which can be gotten by observing the ripples in the water (fig. 11). The waters covered the roots of these trees for eight days with no serious results even though they were in fruit. And indeed trees seem to thrive best when the roots are subjected to the periodic submerging of the tide waters. These are some of the typical conditions under which the best lychee in Kwangtung are grown. The dykes are often used as promenades for which the trees make a beautiful setting even when old and neglected (fig. 12). Intercropping is often practiced on the wider dykes through the center of which is a path, often a public roadway. In the illustration lychee trees with their young spring growth of twigs are seen on the left and plum trees, in blossom, are on the right (fig. 13).

Throughout north and south China the special product of this Canton delta is commonly called "Ling Nan" lychee (嶺南荔枝). Ling Nan (嶺南) is a range of mountains extending from western China through Kweichow, Hunan and Kwangsi, along the northern borders of Kwangtung to Fukien. The name "Ling Nan" is also applied to an educational institution, the Canton Christain College (嶺南大學), which has appropriately centered its attention upon the lychee. Beautifully situated on the Pearl river, three miles south-east of Canton city, the college farm offers ideal conditions for experiments in both wet and dry culture of the lychee. The college has acquired river-bottom land, surrounded by dykes upon which are growing mature trees of the "Wai chi" (淮支) variety. When these dykes at Ling Nan (嶺南) are in fruit they present an interesting sight. Students gladly purchase the fruit by the tree paying handsome prices and perch in the branches and enjoy a luscious repast (fig. 14).

When the dykes are in fruit the trees must be protected by crop watchers, who both day and night remain in straw sheds constructed close to the trees (fig. 15). This custom is followed throughout the delta for each farmer must provide his own crop protection, and lychee fruits are the favorite prey of marauders. Not all the fruit of the college is sold by the tree, some being picked and packed into characteristic and convenient bamboo baskets used by the Cantonese farmers (fig. 16). Each student makes a careful study of the fruit (fig. 17) and each class anxiously looks forward to its lychee practicum (fig. 18). No inducement is necessary to popularize the "Ling Nan" lychee among the American and European staff.

Some idea of the districts and places in which the lychee and lungan are produced, especially those in Kwangtung, may be gained by turning to the Bibliography of Chinese References in Appendix I.

PLATE XI



FIGURE 14.—Canton Christian College Students Picking Lychee along the Dykes.



FIGURE 15.—Crop Watcher and His Thatched Hut along the Dykes.



FIGURE 16.—Baskets of Ling Nan Lychee Ready for Market.



FIGURE 17.—Fruiting Clusters of Ling Nan Lychee.



FIGURE 18.—Canton Christian College Middle School Students in Lycée Practicum.



FIGURE 19.—A Heavily Fruiting Limb of Lychee.



FIGURE 20.—The Lychee, a Heavy Bearer.

CHAPTER VII

SOME IMPORTANT LING NAN LYCHEE CENTERS

In the Ling Nan (嶺南) region there are many places famous for lychee and lungan production. Interesting customs and history are in many cases connected with the lychee and lungan industry of these places. The districts of Nan Hai (Nam Hoi 南海); Pan Yu (P'un U 番禺), Tung Kuan (Tung Kun 東莞), and Tseng Ch'ing (Tsang Shing 增城) are especially noted in this connection.

LI CHIH WAN (荔枝灣): CANTON'S PUBLIC FRUIT PARK

Fruit parks near some of our large western cities might prove profitable or philanthropic investments for those interested in public welfare. The city of Canton has such an open-air resort, privately managed by individual landholders as a commercial proposition. Li Chih Wan (Lai Chi Wan 荔枝灣), ideally located in P'an T'ang (P'un T'ong 泮塘), at the extreme northwest of Canton city, provides an ideal pleasure place for the people of this city, especially for those of Si Kuan (Sai Kwan 西關), the aristocratic western suburb. P'an T'ang (P'un T'ong 泮塘) is low and abounds in quiet streams which are particularly adapted to boating. Throughout Li Chih Wan (Lai Chi Wan 荔枝灣) the banks and dykes of these streams are planted with lychee. Owners of the different sections vie with one another in securing trees of the best varieties and types. Li Chih Wan (Lai Chi Wan 荔枝灣) is a favorite rowing park and when these trees are in fruit it is visited by thousands who glide up and down the streams in little boats, purchasing from care-takers the fresh fruits of these trees. Sometimes special parties will procure in advance the privilege of securing all the fruit of one tree and will on some special occasion repair to its shade for a family picnic. These trees are given the best cultural attention possible, resulting in some magnificent specimens (figures 19 and 20). The dykes are carefully maintained and the trees, when in fruit, are protected from the ravages of birds by meshed wire stretched across high poles which have been placed about the trees (figure 21). Rustic stone steps lead from the streams to the paths of these dykes (figure 21). Here and there along the banks small bamboo structures are provided during the fruiting season

for the special sale of the fruits. Within, tables are provided and an attendant is quite ready and able to tell one the characteristic merits of each variety of fruit. The fruit is sold by the catty (one and one-third pounds) and boat loads of people row up to the steps of these stands, purchase the fruit and again row out into midstream to enjoy it.

Under these unusual conditions it is not surprising that the fruit produced in this region brings high prices because of the demand which has been so uniquely created. The wealthier classes of Canton, many of whom live in close proximity to Li Chih Wan (Lai Chi Wan 荔枝灣), invest liberally in this project as it brings them good returns and at the same time provides considerable pleasure.

CHIA T'ANG SZ (葵塘司): AN EXTENSIVE LYCHEE PRODUCING REGION

Canton city falls within two districts. The western part is located in Nan Hai (Nam Hoi 南海) and the eastern part in Pan Yu (P'un U 番禺). Li Chih Wan (Lai Chi Wan 荔枝灣) to the northwest is in Nan Hai (Nam Hoi 南海). But to the southeast in the district of Pan Yu (P'un U 番禺) is a region far more extensive in its production than Li Chih Wan (Lai Chi Wan 荔枝灣).

Canton city is located on the northern shore of the Pearl river. Opposite the city, and extending southeastward is the island of Honan (Honam 河南), dividing the Pearl river into what are known as the upper and the lower reaches. Along the northern face of this island is a low ridge of hills, upon several of which the Canton Christian College (嶺南大學校) is situated. The southern and southeastern sections of Honan island are extremely low and well watered and are protected from the northern winds by this low ridge of hills. The whole situation is specially favored for lychee culture of the water type. The region has been skillfully dyked and the rich, delta soil has been raised up in beds which are twenty to thirty feet wide and with ditches or canals ten to fifteen feet wide, and five or ten feet deep, intervening. These beds are then planted in fruit: lychee, pummelo, oranges, carambola, guava and other fruits. A view of these wonderful orchards, taken from the foothills to the north, is indeed impressive; especially in the spring when the odor of the citrus blossoms is wafted across on the southern breezes. But when one tries to enter these orchards he finds them

almost impenetrable because of the labyrinth of canals and ditches formed by the raising up of the beds of earth upon which the fruit is grown.

This region, including the whole island of Honan is known as Chiao T'ang Sz (Kau T'ong Sz 葵塘司) which is one of the main divisions of Pan Yu (P'un U 番禺) district. The orchard practices of this section provide fascinating studies and the fruit industry therein found has given renown to such places as Lun T'ou (Lun T'au 灣頭), Tu Hua (T'o Wa 土華), Pei Shan (Pak Shan 北山), Li Chiao (Lik Kau 濠窖) and Shang Yung (Sheung Ch'ung 上涌). Most of the inhabitants of these places are farmers who are well acquainted with this particular type of "water farming." They deserve great credit for the success they attain under such peculiar orchard conditions. There are about twenty varieties of the lychee grown in this region and very little grafting is practiced, almost all of the trees being propagated by the method known as "Chinese air-layering."

LO KANG TUNG (蘿崗洞): A MOUNTAINOUS LYCHEE COUNTRY

In striking comparison to the low, dyked land of Chiao T'ang Sz (Kau T'ong Sz 葵塘司), so famous for its lychee orchards planted on raised beds of rich, delta soil, are the terraced hills and mountains of Lo Kang Tung (Lo Kong Tung 蘿崗洞). Here is to be found another interesting type of fruit culture very different from that of the low, delta regions and proving clearly the ability of the Chinese peasant to adapt his culture to whatever his conditions are.

Lo Kang Tung (Lo Kong Tung 蘿崗洞) also in Pan Yu (P'un U 番禺) district, but in the division known as Lu Pu Sz (Luk Po Sz 鹿步司), is northeast of Canton city and is easily accessible. The region known under this name comprises thirty-six villages the surname of all of the inhabitants of which is Chung (鍾). The region is well favored in that it is high and well drained and has a southeastern exposure, a high range of hills protecting it on the north. This country is visited yearly by hundreds of people from Canton city, especially in December when apricot and plum are in flower. The sight of these trees rivals that of cherry blossom season in Japan. Lo Kang (Lo Kong 蘿崗) is readily reached by rail from Canton by disembarking at Nan Kang (Nam Kong 南崗), the fifth station east of Canton on the Canton Kowloon Railway. From this station there is a crude narrow-gauge branch line running northward. Over this one

enjoys a thrilling ride to Lo Kang Hsu (Lo Kong Hu 濠崗墟), a market town and center of the whole region. Several miles beyond this in the hills is a temple known as Lo Feng Ssu (Lo Fung Tsz 龍峰寺) in which a traveller can readily find accomodation for the night or for days if he so desires and has made provision for his own food and bedding.

Lo Kang Tung (Lo Kong Tung 濠崗洞) is noted for its fruit production, especially the lychee and lungan, mei (mui 梅)—*Prunus mume* S & Z, Wu lan (U lam 烏欖)—*Canarium pimela* Koen, Pai lan (Pak lam 白欖)—*Canarium album* (Lour.) Raench, Feng li (Fung lut 鳳梨)—*Castanopsis mollissima* Bl. and Shih (Tsz 柿)—*Diospyros kaki* L. These fruits are sometimes planted in orchards at the foot of the hills, but most of the hills and mountains have been terraced by this industrious people and thus are made useful for fruit growing. The level beds, fifteen to twenty feet wide, follow the line of the hills and each step, perpendicular to the bed, is four to six feet high (figure 22). On these beds the fruit trees are planted with exceedingly good results but with little uniformity of kind of fruit or of distance between the trees. In the lychee season the sight is magnificent and as described by the Chinese is "like a red cloud." Lo Kang (Lo Kong 濠崗) is especially famous for its production of No mi chih (No mai t'sz 糯米糍) and Kuei wei (Kwai mi 桂味) varieties, although the village of Shui Si Ts'un (Shui Sai Ts'un 水西村) is especially noted for Ya niang hsieh (A neung hai 亞娘鞋) and Chiang chun li (Tseung kwan lai 將軍荔). In this whole section the success of the lychee industry is doubtless due to a method of propagation which, the people have discovered, brings excellent results and which is not practiced so extensively at other places. The Shan chih (Shan chi 山枝) or mountain variety is used for stock and after the trees have attained a trunk diameter of four to eight inches and are firmly established they are cleft grafted to the better varieties. The people of this whole country are well acquainted with lychee and lungan culture and many of the dried lychee and lungan for export are produced here.

'TSENG CH'ING (增城): THE HOME OF A LYCHEE OF NATIONAL FAME

Over the ridge of hills on the north of Lo Kang (Lo Kong 濠崗) is the district of Tseng Ch'ing (Tsang Shing 增城), famous, too, for its lychee production; especially so because it is the home of the renowned Kua lu (Kwa luk 掛綠) or "Hanging green" lychee. This



FIGURE 21.—The Lychee Protected from Bats by Wire Netting.



FIGURE 22.—Terraced Hillsides of Lo Kang Planted to Lychee and Canarium.

in this section and many magnificent trees of both can be seen. Many varieties of both fruits are reported from this section and there are some other special varieties selling at fabulous prices.

FANG YUNG (鳳涌): A LYCHEE NURSERY VILLAGE

The lychee industry is so extensive in Kwangtung as not only to warrant the acquisition of special tracts of land for its culture and sale, but likewise for its propagation. Tseng Ch'ing (Tsang Shing 增城) and Tung Kuan (Tung Kun 東莞) are perhaps the two most famous Ling Nan lychee districts. In the heart of the latter is the village of Fang Yung (Fung Chung 鳳涌), quite widely noted throughout the Canton region for two great achievements: the production of lychee nursery stock and the proud possessor of a citizen who, under the old order, secured the T'an Hua (探花) or third scholarship degree from Peking. When I first met Fang Yung's (Fung Chung's 鳳涌) energetic lychee promoter and nurseryman he eagerly told me of their wonderful trees and of the fact that he is a relative of Kwangtung's famous scholar and official.

Sin T'ang (San T'ong 新塘) a city of 20,000 inhabitants and a large center for lychee and lungan trade, is on the Canton-Kowloon Railway only about twenty-one miles east of Canton city. Sin T'ang (San T'ong 新塘) exports large quantities of these fruits to Singapore and abroad. The railway station is quite a distance from the city which is located on the north bank of the East river. As one walks from the railway to the city, over the intervening hill land, he cannot help but notice lychee and lungan trees, interspersed with bamboo and the canarium trees for which the region is also especially adapted. The lychee is well adapted to undrained regions, but that it also thrives on the hills is quickly evident when one views some of the beautiful orchards of this region (figure 25) which in general appearance are not unlike apple orchards of western countries.

Tseng Ch'ing (Tsang Shing 增城) lies to the north of the East river while Tung Kuan (Tung Kun 東莞) district is to the south. This district is low and has scores of canals leading inland, watering vast fields of rice and sugar cane. The land in this region is worth two to three hundred dollars gold an acre and lychee groves are seen everywhere proving how profitable the crop must be.



FIGURE 25.—Upland Plantations of Lychee at Hsin T'ang (San T'ong) Not Unlike Apple Orchards.



FIGURE 26.—Fang Yung Lychee Nurseries with Mango Windbreak.



FIGURE 27.—Fang Yung Lychee Orchard of Named Varieties for Propagation.

Fang Yung (Fung Chung 鳳涌) is in the heart of this Tung Kuan (Tung Kun 東莞) region, only three and one-half miles distant from Sin T'ang (San T'ong 新塘). For generations the people of this village have been in the business of lychee and lungan propagation and the nurseries are but a stone's throw from the village. Carefully protected on the north by the houses of the village, and by a magnificent mango hedge, this nursery (figure 26) provides a living for scores of families living in the village. The question of parent trees is not neglected and the village prides itself on its rare collection of costly varieties (figure 27), from which it propagates by layering. Radiating in all directions from this village are paths leading no great distance to groups of various varieties. Here we find a group of No mi chih (No mai ts'z 糯米糍) trees; in another direction is a pair of Ta tsao (Tai tso 大造) trees (figure 28); while still in another direction is a magnificent old specimen of Hsi chio tsu (Sai kok tsz 犀角子), the trunk of which is at least ten feet in circumference and beautifully covered with lichens and vines. A life-long friend of this old tree is seen, in winter garb, seated at the base of this tree (figure 29). Several days may be spent to advantage at this spot, inspecting the best trees and inquiring with regard to nursery and cultural methods, and in the study of varieties represented in this village. The simplicity and hospitality of the country folk is inspiring and makes one forget the immediate surroundings of an unsanitary Chinese village. But these people spend most of their time in the open country, which in beauty rivals that of our own land.

CHAPTER VIII

THE CLIMATE BEST ADAPTED TO THE

LYCHEE AND LUNGAN

A study of the range of these fruits indicate that they are decidedly sub-tropical, thriving best in regions not subject to heavy frost but cool and dry enough in the winter months to provide a period of rest. In China and India they are grown between 15 and 30 degrees north latitude.

The Canton delta, in which these fruits are indigenous, is crossed by the Tropic of Cancer and is a sub-tropical area of considerable range in climate. Great fluctuations of temperature are common throughout the fall and winter months. In the winter sudden rises of temperature will at times cause the lychee and lungan to flush forth their beautifully colored orange and garnet brown new growth. This new growth is seldom subject to a freeze about Canton. On the higher elevations of the mountainous regions which are subject to frost the lychee is seldom grown. The lungan appears in these regions more often but it, too, cannot stand heavy frosts. The more hardy, mountainous types of the lychee are very sour and those grown near salt sea water are said to be likewise. The lychee thrives best on the lower plains where the summer months are hot and wet and the winter months are dry and cool. The lungan thrives on higher ground than the lychee and endures more frost.

Some idea of the weather conditions in the vicinity of Canton, where the lychee and lungan flourish, is made possible by a study of the records of the Kwangtung Agricultural Experiment Station (廣東農林試驗場). These records are quite complete from 1913-1919 and a study of the rainfall, temperature and humidity charts for this period reveals the following:

AVERAGE CANTON WEATHER RECORDS FOR SEVEN
YEARS (1913-1919)¹

	Av. Min. Temp.	Av. Max. Temp.	Humidity	Rainfall
January	8.69 C.	19.08 C.	69.54	14.90 mm.
February	11.05	19.04	78.30	57.94
March	13.94	20.64	81.13	75.97
April	17.99	25.75	82.20	146.68
May	21.74	28.94	81.42	253.60
June	24.53	31.16	83.58	263.26
July	25.12	32.58	80.67	231.26
August	25.18	32.73	80.31	258.54
September	23.62	31.85	77.62	148.40
October	20.13	29.69	73.27	38.47
November	15.17	24.27	71.70	58.86
December	10.78	20.29	70.62	33.92
Total				1581.80 mm.
				62.3 inches

A close analytical study of the records of the Kwangtung Agricultural Experiment Station for the seven year period shows that the average lowest monthly temperature for the period, in January, 1918, was 5.43 C. (41.8 F.). The average highest monthly temperature, in August, 1916, was 34.2 C. (93.6 F.). The lychee and lungan flower in March and April when the highest monthly temperature averaged 20.64 C. (69.2 F.) and 25.75 C. (78.3 F.) respectively; and the lowest 13.94 C. (57.1 F.) for March and 17.99 C. (64.4 F.) for April. The average rainfall during these months was 75.97 m.m. (3 in.) for March and 146.68 m.m. (5.77 in.) for April. March and April are months of dark, cloudy days with comparatively little sunshine and high average humidity. During these months the cold, north and north-east winds of winter have changed to the warm and balmy east and south-east winds of spring. The Chinese orchardist is quick to recognize the ill effects to his trees in flower of a day or two of cold rains when the wind veers to

¹ Acknowledgement is due Director Huang Tsun Keng (Wong Tsun Kang 黃遵庚) of the Kwangtung Agricultural Experiment Station (廣東農林試驗場) for access to data from which the above was compiled.

the north and the driving sheets of rain blast the opening flower buds. The fruits of the lychee and lungan form and develop very quickly during a most intense growing period from May to August. The country at this time is undergoing its heaviest rainfall and the humidity is high. The highest average monthly rainfall record for this period was in August, 1918, when 564.7 mm. (22.23 in.) fell; the lowest was in April, 1913, and amounted to 85.8 mm. (3.37 in.). The average yearly rainfall for the seven year period was 1581.80 m.m. or 62.3 inches. Frosts are very light within the delta but during the summer months the region is subject to severe typhoons and floods.

Considerable work is still to be done in the study of the frost resistance of this tree and in the acquisition of varieties especially adapted to cooler climates. Hsu Po (徐勃)¹ in his work on the lychee, says, "They are only suitable for hot, low countries and greatly fear altitude and cold, but when care is bestowed they can be protected." Ts'ai Hsiang (蔡襄)² reports: "Three marches to the west of Fuchow there is a locality called Shui Wai, where the climate is a little colder and where the lychee cannot be planted." The Superintendent of the Government Botanical Gardens at Saharanpur, India,³ latitude 28 degrees north, has known the lychee to endure a freeze of 21 degrees with the loss of only a few leaves. He says that the lychee is harder than the mango but has grave doubts of any variety that will stand snowfall. He reports that Dehra Dun is very little cooler than Saharanpur, yet there is a difference in the fruit. The fruits from the Dehra Dun trees are more acid. This statement with regard to the inability of the lychee to withstand snowfall is corroborated by Sung Chia (宋珏)⁴ when he reports a snow fall of several inches at a place called Cheung Lok

¹ HSU PO (徐勃), Li Chih P'u (荔枝譜) in *Ku Chin Tu Shu Chi Cheng* (古今圖書集成), *Po Wu Hui Pien* (博物彙編), *Ts'ao Muh Tien* (草木典), section 274 (第二百七十四卷); *Li Chih Pu* 2 (荔枝部二), page 4 (第四頁).

² TS'AI HSIANG (蔡襄), Li Chih P'u (荔枝譜) in *Ku Chin Tu Shu Chi Cheng* (古今圖書集成), *Po Wu Hui Pien* (博物彙編), *Ts'ao Muh Tien* (草木典), section 273 (第二百七十三卷), *Li Chih Pu* 1 (荔枝部一), page 4 (第四頁).

³ Office of Foreign Seed and Plant Introduction, United States Department of Agriculture, Washington, Correspondence, Reports, etc.

⁴ SUNG CHIA (宋珏), *Li Chih P'u* (荔枝譜) in *Ku Chin Tu Shu Chi Cheng* (古今圖書集成), *Po Wu Hui Pien* (博物彙編), *Ts'ao Muh Tien* (草木典), section 273 (第二百七十三卷), *Li Chih Pu* 1 (荔枝部一), page 10 (第十頁).

when the mountains became white and the natives were greatly surprised. He says, "That year all the lychee trees died off but after several years sprouted out again."

Mr. George Campbell ¹ of Ka Ying (嘉應州), Kwangtung, China in January, 1913, reported, "I have been in Ka Ying for 25 years and 18 years ago I can remember a cold snap when the thermometer went to 24 degrees. The lungan trees were killed and for years afterwards we got very few lungans. The lichee trees were also killed though some of them sprouted out again and are now bearing. This month we had a severe frost, the worst since '93, and these trees and their cousins were hard hit." More than 20 years ago Theodore L. Meade of Oviedo, Fla., reported that the tree grows well there but suffers much from frost. In the winter of 1888-89 a temperature of 27 degrees cut his tree back but little, while 21 degrees killed it to the ground in 1890. Mr. Reasoner of the Royal-Palm nurseries, Oneco, Florida, reported March 11, 1916, "My little lichee trees were untouched by these freezes. A week ago we had 29 degrees and yesterday 30 with a very hard frost indeed. I just saw them and they are O.K." In a letter to the writer, after the severe freeze of February, 1917, Mr. Reasoner's conclusions were, "There is no doubt but that these trees are much more hardy than mango trees, but not so hardy as lemon trees. The leaves cannot stand very severe freezing."

In conclusion it is safe to assume from the records at hand that the lychee will prove most profitable when grown at low altitudes, in sub-tropical regions not subject to temperatures much below 30 degrees Fahrenheit. If the tree is kept dormant and somewhat protected in the winter it can possibly endure slight frosts. Doubtless lychee trees could be protected from cold much as orange and lemon trees are in Florida and California. The lungan will endure more cold than the lychee but thrives best under conditions favorable to the lychee.

¹ Office of Foreign Seed and Plant Introduction, United States Department of Agriculture, Washington, Correspondence, Reports, etc.

CHAPTER IX

SOILS ADAPTED TO THE LYCHEE AND LUNGAN

AND

CULTURAL METHODS

The Chinese believe that the type of fruit produced depends as much upon the care of the tree as upon the variety or climate. A successful lychee grower is ever on the alert to minister to every whim of the plant's desire. In Kwangtung, lychee orchards are rarely seen exposed to strong, north, winter winds. A low situation to the south of a hill is preferable for large plantations.

The lungan is more seldom grown under orchard conditions than is the lychee. There is not so large a demand for this fruit and the trees therefore more scattered although one often finds attractive groups of lungan. The lungan tree endures the cold, north winds better than the lychee but does not thrive so well under water culture. But trees are often planted along the banks of ponds where roots have plenty of access to water with exceedingly good results.

Dyke Plantings

The delta of the Pearl is low and an extensive system of dykes holds back the water of the streams from the rich delta lands. The lychee is the favorite tree for these dykes and a considerable proportion of the fruit produced in Kwangtung is grown on these embankments. But lungan are rarely seen growing on these dykes. Lychee trees planted along the main dykes of the streams are more susceptible to the cold, wintery winds; and when the dikes are built in series, the second and third are always considered preferable for the lychee, especially when the situation is on the northern side of the stream (figure 6). In South China dyke lychee are usually planted 20-25 feet apart and a low spreading head is developed (figure 9). In some cases intercropping with banana, guava or even plum (figure 13) is practiced while the lychee are still young.



FIGURE 28.—Pair of Ta tsao—Large crop—Lychee Trees.



FIGURE 29.—Fang Yung Nurseryman Seated under Hsi chio tsu—Rhinoceros horn—Lychee Tree.



An Acid Peaty Soil Better for the Lychee Than an Ordinary Fertile Soil.
(See page 151 and the detailed description of illustrations.)
(One-fifth natural size.)



Healthy Lychee Root, Grown in Acid Soil, Showing the Mycorrhizal Tubercles.

(See page 152 and the detailed description of illustrations.)

(Magnification 6 diameters.)



FIGURE *a*.

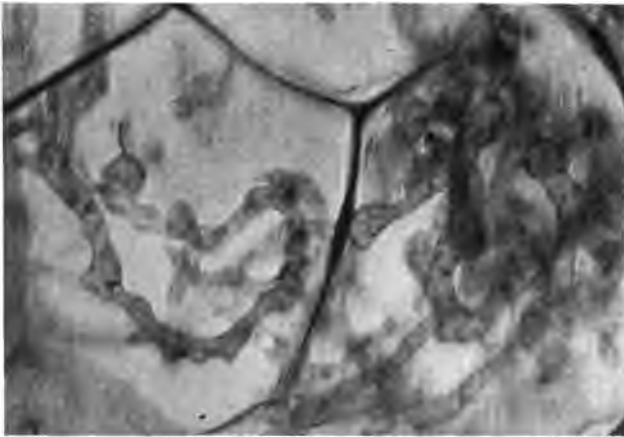
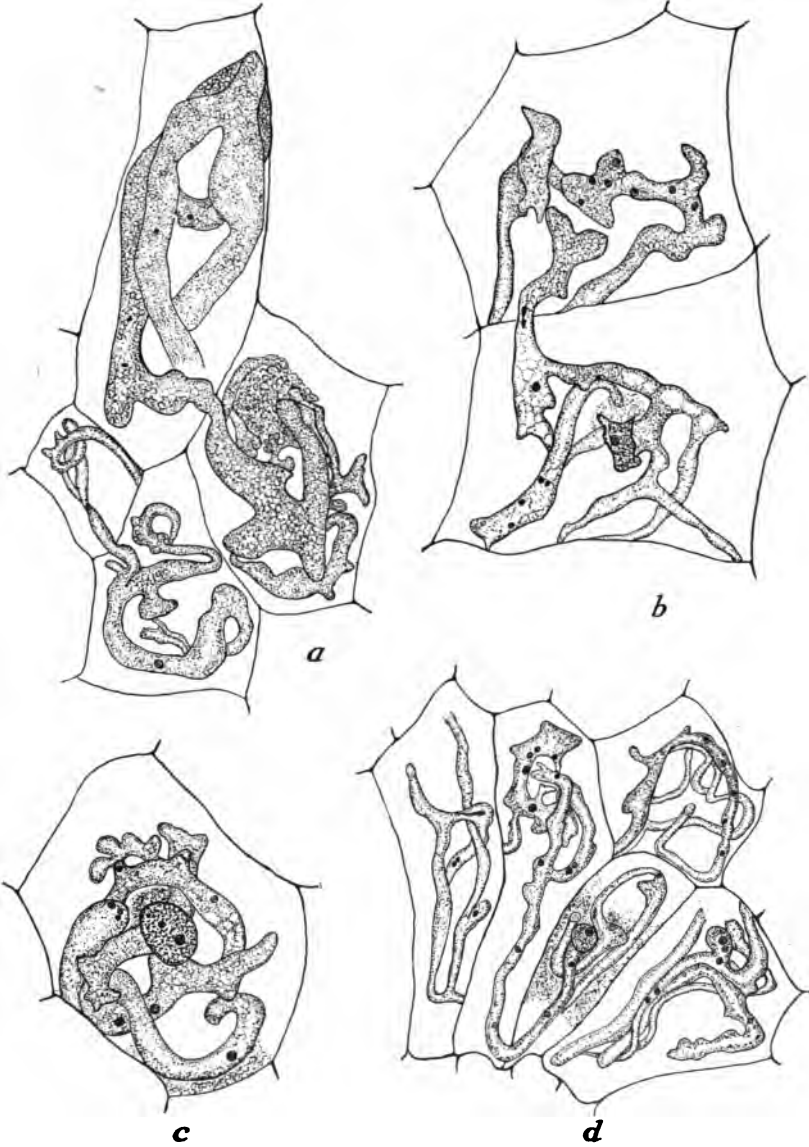


FIGURE *b*.

Enlarged Sections of Lychee Root Tubercles Showing the Cells Gorged with the Mycorrhizal Fungus. Microphotographs by Dr. Emil G. Arzberger.

(See page 152 and the detailed description of illustrations.)
(FIGURE *a*, magnification 195 diameters; FIGURE *b*, magnification 830 diameters.)



Mycorrhizal Fungi in the Cells of Lychee Root Tubercles.

Drawings by Dr. Emil G. Arzberger.

(See page 152 and the detailed description of illustrations.)

(FIGURES *a*, *b*, and *c*, magnification 775 diameters; FIGURE *d*, 500 diameters.)



FIGURE 30.—Raised-bed Lychee Plantation Showing Water-channel.



FIGURE 31.—Low-lying Delta Lychee Plantations Showing Well-constructed Bridge across Canal.

Raised-bed Plantations

The *raised-bed system* of orchard planting, so frequently employed in the Canton delta, seems especially adapted to the lychee and a very large acreage of lychee is thus grown. This system could doubtless be employed to advantage in some of the swampy areas of the United States which now lie waste. In Kwangtung wide, open ditches, at a distance of thirty to forty feet apart, are dug through land which is low and subject to flood or to submersion at high tide. These ditches are ten to fifteen wide, when the excavated earth is thrown up on the other side, the surface of the beds are 10-15 feet above the bottom of the channel, which drains out freely when the tide is low. The lychee trees are planted more or less irregularly along either side of these beds so that the limbs of the trees, when mature, stretch across these channels and meet in the center (fig. 30). Lychee are often intercropped with guava or orange where this system is used. The conditions secured by this raised-bed method seem ideal for lychee culture and vast areas of otherwise useless land are thus made profitable. When one looks down from a high vantage point over an area such as this, he might think he was looking down upon a vast apple orchard (fig. 31), but let him try to enter and he soon becomes lost in the net work of beds and streams.

Upland Lychee Orchards

Upland lychee orchards, though perhaps not so common in Kwangtung as low-land, are nevertheless common in hilly countries like Lo Kang (Lo Kong 羅岡) and Tseng Ch'ing (Tsang Shing 增城). In the upland culture of lychee the trees are sometimes scattered irregularly over the hills and intercropped with other fruits; but sometimes they are planted in regular orchard formation with at least thirty feet between the trees and with very little tillage after they become mature. Orchards of lychee thus planted are not unlike apple orchards in general appearance (fig. 25).

Artificial irrigation is not necessary in these upland groves of Kwangtung but would doubtless prove profitable in regions with less rainfall and humidity. When the trees are grown under these higher conditions the soil is usually a sandy loam with clay subsoil. The abundant rainfall during the fruiting season provides sufficient moisture to bring the tree to a profitable fruiting condition. But in any country where this moisture is lacking during the growing season liberal irrigation should be practiced, and what might usually be considered an excess water supply may be provided with profit.

Soils, Preparation and Transplanting

A loam is most desirable for the lychee and the so-called river mud of the Canton delta seems to meet the highest soil requirements. Mr. Humphrey G. Carter,¹ Economic Botanist at Calcutta, India, writes that the Mozufferpore lychee is the best in India and that the soil there is moist, sandy and mixed with a sufficient quantity of rich clay. He considers that old river beds make excellent lychee gardens.

In Kwangtung little soil preparation is made for the tree prior to planting. Where the soil is especially hard, small pits are sometimes dug and these are filled with specially prepared soil. The farmers rarely grow their own trees, but procure layered stock from the nurseries.

The planting is done in March and April at about Ts'ing Ming (清明), that season in China which is devoted to the worship of graves. At this time the soil has begun to warm up and sufficient rainfall is assured to give the trees a good start. At the time of transplanting the branches are not trimmed back very severely. The Chinese claim that unless the young tree has sufficient foliage to enable it to benefit from the morning dews it will get a poor start. Tang Tao Hsieh (鄧道協),² in his treatise gives explicit instructions not to trim off the leaves at the time of transplanting. After planting, the trunk and limbs of the young trees are often wrapped with rice straw to prevent excessive evaporation or sun scald in summer and excessive cold in winter.

¹ Carter, Humphrey G., in correspondence with Office of Foreign Seed and Plant Introduction, Bureau of Plant Industry, United States Department of Agriculture, Washington, D. C.

² TANG TAO HSIEH (鄧道協), Li Chih P'u (荔枝譜) in *Ku Chin Tu Shu Chi Cheng* (古今圖書集成), *Po Wu Hui Pien* (博物彙編), *Ts'ao Muh Tien* (草木典), section 274 (第二百七十四卷), *Li Chih Pu* 2 (荔枝部二), page 6 (第六頁).



FIGURE 32.—Fertilizing Dyke Lychee with Night Soil.



FIGURE 33.—Beds of Lychee with Holes for Night Soil Fertilizer.



FIGURE 34.—Unloading a Night Soil Boat for Fertilizing Lychee.

Fertilization

The Chinese maintain the quality of the fruit is very largely dependent upon carefully feeding the plants and this is wisely done from the time the young trees begin to make their first growth. Careful yearly nourishment of the fruiting wood is provided. The tree is naturally a surface feeder (fig. 4) and when grown under raised-bed and dyke conditions this characteristic is greatly encouraged by pouring liquid fertilizer, usually night soil, into little shallow holes or furrows dug about the tree at a distance not greater than six or eight feet from the trunk (fig. 32). This is usually done in early spring and each mature tree in bearing is given no less than five hundred pounds of this very concentrated liquid manure. On narrow dykes it is poured into holes dug along the center of the dyke so as to assure a minimum loss from seepage (fig. 33).

This night soil is transported in boats built for the purpose, which enter the streams and canals and greatly facilitate the work of manuring (fig. 34). No Cantonese could be termed a farmer unless able to shoulder two buckets of water or fertilizer, one swung from either end of a bamboo pole which balances across the shoulder as he gracefully trots to and from the fields. • The work of fertilizing is facilitated by a wooden dipper attached to one end of this bamboo pole (fig. 34). When the boats reach the dykes the liquid manure is poured, by means of this dipper, into wooden buckets provided for the purpose (fig. 40) and carried to the trees.

Mulching

The lychee should profit greatly by mulching, though the Chinese do not seem to practice it to any great extent. But they are exceedingly careful in the wet culture of the tree almost every year to cover any exposed roots with a smear of canal mud. In the colder districts they often bank the trunk and roots with this mud, mixed with manure, and thus both protect the tree in the winter and prepare for the coming months of spring when plant food will be necessary. Tang Tao Hsieh (鄧道協)¹ in his treatise on the lychee reports that it is this custom, practiced by the farmers of Fang Kang (Fung Kong 鳳岡), Fukien, that has made the lychee of that place the most superior.

¹ TANG TAO HSIEH (鄧道協), Li Chih P'u (荔枝譜) in *Ku Chin Tu Shu Chi Cheng* (古今圖書集成), *Po Wu Hui Pien* (博物彙編), *Ts'ao Muh Tien* (草木典), section 274 (第二百七十四卷), *Li Chih Pu* 2 (荔枝部二), page 6 (第六頁).

Thinning, Pruning and Yield

Thinning is seldom practiced on the lychee; more on the lungan. Some pruning is done by the Chinese in early winter, but it is customary to break off many of the twigs and branches at the time of harvesting the fruit and this is recognized as a form of pruning. Under favorable conditions the tree is a heavy bearer, yielding on rough estimate as much fruit as apple trees of equal size. Chi Han (嵇含)¹ in his *Features of Plants in the South* reports that from one tree as many as one hundred "tau" (equivalent to about 1000-1500 lbs) can be gathered.

Picking and Protection

The fruit adheres very tenaciously to the tree and crude knives are often used in chopping the clusters of fruit, with twigs attached, from the tree, a custom which as shown has doubtless given the lychee its name. Considerable superstition exists with regard to the picking of the fruit. One belief is that no fruit should be removed before the time of picking; and when once picking has started the tree should be picked clean, as birds and insects will immediately attack any fruit which remains. This belief doubtless serves a worthy purpose as the temptation to sample the fruit is great and the grower always has a good reason to prevent it. At Tseng Ch'ing (Tsang Shing 增城) we were told that the pickers of the Kua lu (Kwa luk 掛綠) were always required to sing songs while picking to guarantee that they were not eating any of the fruit.

Ts'ai Hsiang (蔡襄)² refers to customs connected with picking the lychee in these words: "When the ripening season comes all fruits should be picked from the tree, then neither insects nor birds will dare to come near. If the fruit is only partially gathered from the tree, it will become infested with bats, bees and grubs, the latter eating into the tree. In order to drive off these pests the

¹ CHI HAN (嵇含), *Nan Fang Ts'ao Muh Chuang* (南方草木狀) in *Ku Chin Tu Shu Chi Cheng* (古今圖書集成), *Po Wu Hui Pien* (博物彙編), *Ts'ao Muh Tien* (草木典), section 273 (第二百七十三卷), *Li Chih Pu* 1 (荔枝部一), page 2 (第二頁).

² TS'AI HSIANG (蔡襄), *Li Chih P'u* (荔枝譜) in *Ku Chin Tu Shu Chi Cheng* (古今圖書集成), *Po Wu Hui Pien* (博物彙編), *Ts'ao Muh Tien* (草木典), section 273 (第二百七十三卷), *Li Chih Pu* 1 (荔枝部一), page 4 (第四頁).

orchardist or gardener places four posts around the tree and on top of these he builds a small house. During the night someone dwells in this place in order to startle these various pests when they come to plunder or destroy the fruit. Another method is to gather some bamboo reeds which are from five to seven feet long, and sway them continually back and forth. This latter method is used to drive off pests like the bats."

No labor difficulties are experienced in picking the fruit, though in Kwangtung much of it is picked during the harvest of the first crop of rice or the planting of the second. But labor is as plentiful in China as it is scarce in the West. And this is a legitimate reason why the Chinese should employ so many intensive methods of lychee culture.

CHAPTER X

METHODS OF PROPAGATION

In the Ling Nan region, the home of the lychee, trees are rarely produced from seed. One reason for this is that the seeds of the best varieties are not viable and those that are require 8-12 years to bring the trees into bearing; whereas, by the Chinese method of air layering, fruiting trees are secured in from 3-6 years. Moreover, trees from seed are said not to "come true" with any certainty. And the Chinese consider that in a region where temperature and humidity so greatly facilitate layering there is little reason to depend upon seedlings. Then, too, seeds of the lychee are very short lived and cannot be kept for more than four or five days, except under very moist conditions.

In the propagation of the tree in other lands, however, the seedling method may be advantageous, especially until a large number of trees are at hand. Mr. J. E. Higgins in his bulletin 92 cites some interesting experiments with regard to the use of seeds in propagation and to methods for their shipment over great distances. The writer, following the instructions of the Office of Foreign Seed and Plant Introduction to pack seeds in damp sphagnum moss mixed with ground charcoal, sent a number of tin tubes of Huai Chih (Wai Chi) and Hei yeh (Hak ip) lychee seeds from Canton to Washington. These arrived in good condition and a number of seedlings were grown from them. The Shan Chih (Shan Chi) or mountain lychee, and these two varieties, are the best for the production of seedlings. No difficulties will be experienced if the grower remembers how quickly these seeds deteriorate, follows the usual methods, partially shades his seedlings, and above all else remembers that the lychee is a water-loving plant which can endure great quantities of moisture both in the air and in the soil.

Chinese Air-layering

Most of the lychee trees of South China are produced by a method known as "pok chih" (駁枝), a process of layering which the modern horticulturist has come to term *Chinese Air-layering*. This is practically the same as the "Gootee" layering of India.

PLATE XXVII



FIGURE 35.—Unloading Lychee from District Passage Boats in Canton City.



FIGURE 36.—Nursery Beds of Chinese Air-layered Lychee Trees.



FIGURE 37.—Raising Lychee Nursery Stock with Ball of Earth Attached.



FIGURE 38.—Boat-load of Lychee Nursery Stock.

The Cantonese gardeners are excellent manipulators of this method and a great majority of the shrubs and trees of South China, including citrus fruits, are thus propagated. Lychee trees and limbs from which to propagate are first selected, but except in very rare cases, not with any very careful observation with regard to limb or bud variation. In the spring about the time the trees are coming into flower complete rings of bark are girdled from branches, preferably not more than two inches in diameter. The strip of bark which is removed is about an inch in width and a callus is allowed to form for a day or two before the earth is bound about the new layer. A special preparation of binding mud is made by mixing wet, sticky, canal or pond earth with chopped-up straw or leaves; and little balls of this are bound about each injured branch.

As this process is carried on in the season of dark, cloudy days and considerable rainfall, little further attention is given to the tree. If dry, sunny weather continues for any period the little balls of earth must be watered. The roots begin to form within a few weeks and the new layer is said to be well rooted in about one hundred days when it is removed from the parent tree with a saw. The Chinese say that the layer should be planted out before the little roots emerge from the ball of earth and become dried.

After removing the layers from the parent trees they are set out in nursery beds of specially chosen soil which inclines to a heavy and sticky rather than to a light character. The plants are set out about a foot apart each way in these beds (fig. 36) which are located with reference to protection from cold, wintery winds. Here they remain until at least one year from the following spring. When they are raised for permanent planting (fig. 37), a ball of earth at least a foot in diameter, held in place by means of rice straw, remains attached to the roots.

This nursery business, as seen for example at the village of Fang Yung (Fung Chung 鳳涌) has become quite an industry and the business methods whereby the industry is conducted would be a fascinating study. For example we have been told that many of the trees produced at Fang Yung are layered from trees growing in Chiao T'ang Sz (Kau T'ong Sz 葵塘司) in Pan Yu (P'un U 番禺) district where very interesting contracts are made between the nurserymen and the growers for the production of stock. The nurserymen layer the trees in the groves from trees which they may select and pay for

them by weight at the time they are removed from the trees. The contract calls for the removal of all layered branches whether dead or living and for payment of same. It is said that the average price paid for these layered branches is \$2.50 Mexican per tan (tan 担 or 133 lbs.) for the No mi chih (糯米糍) variety and \$2.25 for the Huai chih (淮枝). This nursery business in lychee and lungan nursery stock is an extensive industry and one often sees boat loads of lychee nursery stock going out from Fang Yung (Fung Chung 鳳涌) (fig. 18).

Layered lychee trees will bear in a few years after they have been set out into the permanent position, but they are not in their prime until from 20-40 years. If properly cared for, they may remain good fruiting trees for more than a hundred years. Chinese history is full of records of large old profitable trees and one author, Ts'ai Hsiang (蔡襄),¹ speaks of a tree three hundred years old which continued to prosper in leaves and fruit. Sung Chia (宋瑋)² referred to a "big tree requiring several tens of men to get around it, the trunk of which is empty and inside of which four or five men can sit."

About Canton thousands of these layered trees are also planted in pots. In the world famous gardens at Hua ti (Fa ti 花地) one will find well established trees of many varieties growing in shallow pots (fig. 39). These can be purchased at prices ranging from 40 cents to \$1.50 gold. The Chinese are very fond of using potted fruits as ornamentals and Chinese gardeners do not fail to bring young potted lychee into bearing (fig. 40) for this purpose. Lychee trees are often thus sent north, a careful calculation being made so as to have them fruit about the time of their arrival.

¹ TS'AI HSIANG (蔡襄), Li Chih P'u (荔枝譜) in *Ku Chin Tu Shu Chi Cheng* (古今圖書集成), *Po Wu Hui Pien* (博物彙編), *Ts'ao Muh Tien* (草木典), section 273 (第二百七十三卷), *Li Chih Pu 1* (荔枝部一), page 3 (第三頁).

² SUNG CHIA (宋瑋), Li Chih P'u (荔枝譜) in *Ku Chin Tu Shu Chi Cheng* (古今圖書集成), *Po Wu Hui Pien* (博物彙編), *Ts'ao Muh Tien* (草木典), section 273 (第二百七十三卷), *Li Chih Pu 1* (荔枝部一), page 9 (第九頁).



FIGURE 39.—Potted Lychee in the Famous Hua Ti Gardens, Canton, China.



FIGURE 40.—Potted Lychee as Ornamentals.



FIGURE 44.—Cluster of No mi ts'z—Glutinous rice—
Lychee.
(One-half natural size.)



FIGURE 46.—Cluster of Hsiang li—Fragrant—Lychee.
(One-third natural size.)

Tang Tao Hsieh (鄧道協)¹ reports this method of "pok chih" (駁枝) also in use in Fukien province. He says, "The lichee are not produced from seed. Good branches are selected, injured and wrapped with mud until white root-like hairs begin to grow out when they are covered with another layer of mud and later cut off. In spring they send out new leaves." Mr. Higgins reports 92 modifications of the Chinese method of air-layering which he has employed in Hawaii.

Propagation by Inarching

Another method of propagating the lychee, and employed especially with the lungan, is the inarch method known by the Chinese under the name *ai chih* (挨枝). The small seeded No mi chih (糯米糍) variety is often thus propagated and high headed trees (see end of bed, fig. 36) with trunks six to eight feet, are often grown in this way. Good strong seedlings usually of the mountain variety, Shan chih (山枝), are first established, often in pots. These plants are raised in spring, carried to the scion trees, inarched, and held in place by bamboo framing until the union has formed.

With regard to the application of this method, Mr. G. W. Oliver, expert propagator at the Washington greenhouses, in a report to the Office of Foreign Seed and Plant Introduction, dated September 1914, says, "We had a considerable number of seedling litchi plants grown from seeds secured from China by your office. When the seedlings were in three inch pots they were used in inarching to small branches on large plants. . . . The litchi inarching work is exceedingly easy and plants could be raised in any quantity provided you had the seedlings and named varieties to work with." In 1910 Mr. Oliver also succeeded in inarching some seedlings of lungan with small twigs of lychee plants which had been secured via Shanghai. This was apparently the first time recorded when the lychee was put on stock other than its own. In his report Mr. Oliver said, "As I recollect I did not have more than three stocks of the longan for the inarching experiments in 1910, and I did not regard them as very successful. But the seedling longans were large

¹ TANG TAO HSIEH (鄧道協), Li Chih P'u (荔枝譜) in *Ku Chin Tu Shu Chi Cheng* (古今圖書集成), *Po Wu Hui Pien* (博物彙編), *Ts'ao Muh Tien* (草木典), section 273 (第二百七十三卷), *Li Chih Pu 2* (荔枝部二), page 6 (第六頁).

plants in six inch pots; had they been used when in three inch pots the results might have been more successful, therefore no reliable deductions could be drawn from what I did with them."

Grafting and Budding

Chinese recognize the art of grafting and on the lychee commonly employ a form of grafting which they call *tsieh chih* (tsip chi 接枝). In using this method it is customary to use the mountain variety "shan chih" (山枝) for stock and after the seedling is three to six years old to cut off the whole head at about five or six feet above the ground and place in a wedge shaped graft of the desired variety. I have never seen them employ grafting wax but they usually cover the point of graft with mud and protect the graft from the hot sun by means of a bunch of rice straw tied over the graft. This method is very common in Lokang (羅岡) and in other places is often used to top-work trees. In Fukien it is also widely practiced both on the lychee and lungan, and Hsu Po (徐燏) in his records of the lychee in Fukien speaks of "tsieh chih" and says, "Secure seedling of the sour kinds, cut off the trunk and use a sharp knife to make a crack and then insert another branch so that the skin of the two comes together. Bind with tree leaves and cow manure mixed with clay." Experiments in grafting and budding the lychee and the lungan have received some attention at the Hawaii Station and a method of bark grafting has proved thus far successful in top working lungan trees to lychee. Mr. Higgins says: "Repeated experiments with this method have shown that there is no great difficulty in securing a union of the litchi with the longan. . . . A noteworthy influence of the stock on the scion should be mentioned here. The growth produced is very much more rapid than that of the litchi on its own roots, and in some cases the character of the foliage appears to undergo a change."

The Chinese apparently do not recognize the art of budding and hence do not employ it on the lychee. Mr. Higgins¹ reports, "The budding of the litchi on the longan has been accomplished in Hawaii, but this method is not so successful as that of grafting described above."

¹ Higgins, J. E., *The Litchi in Hawaii*, Hawaii Agricultural Experiment Station, Bulletin No. 44, page 11.

An Open Field for Experiment with the Lychee

It is apparent that there is an open field for a series of interesting and helpful experiments in the propagation of this attractive fruit. The fact that the Chinese have always propagated a large percentage of their plants by layering has not enabled them to determine the varied results that can be obtained by means of grafting. A series of experiments in grafting, budding or inarching the lychee on stocks other than its own should prove of value to the Chinese in their cultivation of this fruit. It should also prove of value to those countries which are attempting to introduce the lychee under conditions not so favorable as in its native habitat.

Drought and frost resistance are two factors to be kept definitely in mind in this work; and soil variations should be carefully studied. The varied soil and climatic conditions in which the lychee grows in China have resulted in distinct varietal differences which can be utilized to advantage in this work. In this connection it will be a decided advantage to regroup all the varieties of the lychee into the *water lychee* and the *mountain lychee* classification as one Chinese author has attempted to do.

It should be especially noted that a study of the Lychee group of the *Sapindaceae* as outlined under the botanical discussion reveals the fact that we can look with promise to regions remote from those of native habitat for stocks upon which to work the lychee. In particular the wild lychee of the Philippines, *Litchi philippinensis* Radlk. (figure 2), offers great promise of being found useful as a stock since it is the species most closely related to the cultivated lychee, grows on well-drained uplands and on hill and mountain slopes at considerable altitudes and is a tree of great height and large diameter. All this is quite the reverse of the cultivated lychee. Furthermore, this species has large seeds, at least twice the bulk of those of the cultivated lychee, and hence presumably producing more vigorous seedlings. In any attempt to grow the lychee on high, dry situations it is imperative that a test be made of the Philippine wild lychee as a stock. It is also possible that the little known *Pseudonephelium fumatum* (Blanco), Radlk., a tree growing on Luzon Island, Philippines, in Borneo and Perak will upon fuller study prove to be closely related to the lychee. It has flowers destitute of petals like the lychee, whereas the flowers of the lungan and the other species of *Euphoria* have well developed petals. At any rate the effort should be made to utilize also this species as a stock for the lychee which is rather narrowly limited in its range of soil adaptation.

The closely related genus *Euphoria* has already proved promising, recent reports from the Hawaiian Islands indicating success in grafting the lychee on the lungan, *Euphoria longana* Lam. (fig. 59). The allied Philippine form, *Euphoria cinerea* Radlk. (fig. 3) should also be tried and the other nine members of the genus *Euphoria* should not be neglected. All these facts indicate the possibilities of opening up a most interesting study with regard to new methods in the propagation of the lychee which may prove valuable to both China and to other countries.

CHAPTER XI

THE LYCHEE AND LUNGAN IN COMMERCE

Marketing

In a country where transportation facilities have developed so slowly it is not surprising that great sacrifices of growers' profits, and even human life itself, have been necessary in order to get a perishable fruit to a critical public and to a tribute-exacting royalty.

The usual method in the handling of the lychee crop is for the grower to sell to the jobber; the jobber, who is at the mercy of contractors in human labor necessary to transport the product by land or by stream, sells to the city wholesaler; the wholesaler to the retailer; and the retailer to the consumer. Estimates on the value of the fruit are usually made while it is still on the tree; in fact, contracts for the year's crop are often made while the trees are in flower, as this allows a little more leeway for a gamble.

After the fruit is picked it is carefully and neatly packed by these jobbers, the baskets are carefully covered with some of the leaves of the tree and are often made thief-proof by sewing over the top a kind of bamboo matting. They are thus transported to the cities (fig. 35). The wholesale lychee markets in a city the size of Canton are a most interesting study and the questions regarding weights and measures, grades and prices are difficult to comprehend. But interesting information can be secured here with regard to districts and varieties.

Tribute Lychee

Chinese history points clearly to the evils which have accompanied the custom of sending the best produce of the land to the Emperor and his Court. It is fortunate for China that this custom ceased with the birth of the Republic. The demand made by the royal families upon the great lychee producing districts of the south has always been "a thorn in the flesh." It has proved a deterring factor in the development of the lychee industry, as is indicated in many records of the extreme hardship and even sacrifice of life that

was necessary to carry the fruits from south to north. Ts'ai Hsiang (蔡襄)¹ says, "Foochow (福州) usually sends its tribute of lychee in two forms: Hung yen (紅鹽) and Mi chien (蜜煎), or candied lychee. During the Ch'ing Li (慶曆) year of Jen 'Isung (1041 A.D.), Emperor of the Sung Dynasty, the T'ai Kuan (太官) or Official in Charge of the Collection of Tribute, inquired concerning the form in which the yearly tribute was sent. The Chih Chou Shih (知州事), or Prefect of Foochow (福州), told him that the distance was very long and therefore they were not able to send them. The T'ai Kuan (太官) then ordered the number of Hung yen (紅鹽) lychee to be diminished, and the amount of plain dried fruit to be increased

Transportation

Although the lychee is perishable the fresh fruit can be marketed to advantage at great distances from the orchards, as is testified by the fact that in northern China and Japan it is readily found in season on the markets of important cities; and transportation facilities are still very slow in China. Mr. Higgins² in his bulletin gives some interesting experiments with regard to this question and believes "there is no doubt that refrigeration will prove a very satisfactory method for placing upon American markets the litchi crop grown in Florida, California, Hawaii, Porto Rico, or Cuba."

Wholesale Prices of the Fresh Fruit

That the local Canton prices for lychee and lungan are not low is indicated by the following table of prices received by a grower³ who marketed his fruit wholesale:

¹ TS'AI HSIANG (蔡襄), Li Chih P'u (荔枝譜) in *Ku Chin Ti Shu Chi Cheng* (古今圖書集成), *Po Wu Hui Pien* (博物彙編), *Ts'ao Muh Tien* (草木典), section 273 (第二百七十三卷), *Li Chih Pu I* (荔枝部一), page 4 (第四頁).

² Higgins, J. E., *The Litchi in Hawaii*, Hawaii Agricultural Experiment Station, Bulletin No. 44, page 13.

³ Acknowledgement is due Mr. Mo Hui T'ang (莫輝堂) of Pei Shan (北山) for access to his account books whereby it was possible to obtain the following figures.

Wholesale Market Prices for Lychee and Lungan Fruits

per tam (擔) of 133 pounds.

Lychee

	Hei yeh (Hak ip) 黑葉	Kuei wei (Kwai mi) 桂味	No mi ts'z (No mai t'sz) 糯米糍	Huai chih (Wai chi) 淮枝
1909	\$ 7.00 *	15.00	35.00	5.50
1910	6.00	10.00	15.00	4.20
1911	4.90	10.00	15.00	3.50
1912	8.40	21.00	28.10	5.50
1913	9.75	17.80	22.10	7.00
1914	12.00	22.20	35.00	7.60
1915	12.60	20.00	28.10	5.51
1916	7.00	15.00	21.00	4.91
1917	9.80	15.00	21.00	5.51
† 1918	49.40	184.00	111.00	27.80

Lungan

	Shih hsia lung yen (Shap ip lung ngan) 什葉龍眼	Hua kioh (Fa hok) 花殼	Kao yuan (Ko un) 草園
1909	\$ 7.00	\$ 2.98	\$ 3.50
1910	4.91	1.50	2.10
1911	7.00	2.98	3.50
1912	7.00	2.98	3.50
1913	7.00	2.98	3.50
1914	7.00	2.98	3.50
1915	9.80	4.91	5.95
1916	9.80	4.91	5.95
1917	4.91	1.50	2.10
† 1918	29.80	7.00	9.84

NOTES:

* Prices are expressed in terms of Canton local silver the value of which in terms of gold currency varies greatly. In 1914 \$1.00 local silver was equal to about 50 cents United States currency or 2 shillings English currency; in 1919 \$1.00 local silver was equal to about 90 cents United States currency or 5 shillings English currency.

This difference in exchange so favorable to China began after the opening of the European war and has not yet returned to the normal rate existing before the war. But the growers' returns were greater during the years of the war than before. And export prices also fell very little during this period. These facts indicate somewhat how in these modern days international conditions will affect the rural populations of countries even so much cut off from world affairs as those in China.

† The very excessive prices indicated in the year 1918 is accounted for by the fact that there was an exceedingly short crop because of unfavorable weather conditions.

Recipes and Methods of Preservation

Wu Tsai Ao (吳載鰲)¹ in his *Chi Li Chih* (記荔枝) says that the first day after picking, the lychee loses its color, the second day its fragrance, the third its taste; and by the end of the fourth or fifth day all color, taste and fragrance are gone. His statement is overdrawn, though there is nothing quite so delicious as lychee, ripened on and freshly picked from the trees. Wu Tsai Ao (吳載鰲) then devotes a whole section of his treatise to the question of preservation.

Hsu Po (徐勃)² devotes more than half of his work to how to prepare and eat the lychee. He has a number of honied recipes, one of which calls for the mashed green fruit, boiled with honey and then set aside in a jar for one month until it jells. Another: "Secure some fresh lychee and dry them in the sun for one day. Remove the skin and the seeds from the meat, and to each catty add one and one-half catties of white honey. Boil over sand (a slow fire) until there are from 100-1000 bubbles. Pour into earthen jars (not iron), alternately heat and cool for one day, and then in this earthen jar dry the mass in the sun until it solidifies."

The Chinese are connoisseurs in rare and dainty dishes and the lychee has offered an attractive field for the development of this art. Canton restaurants list delicious lychee dishes with meat or syrup dressings and most of the local writers on the lychee have described various methods of salting, preserving, or canning and drying the lychee. Mr. Higgins³ also gives some local recipes for preserving the fruit.

¹ WU TSAI AO (吳載鰲), *Chi Li Chih* (記荔枝) in *Ku Chin Tu Shu Chi Cheng* (古今圖書集成), *Po Wu Hui Pien* (博物彙編), *Ts'ao Muh Tien* (草木典), section 274 (第二百七十四卷), *Li Chih Pu 2* (荔枝部二), page 7 (第七頁).

² HSU PO (徐勃), *Li Chih P'u* (荔枝譜) in *Ku Chin Tu Shu Chi Cheng* (古今圖書集成), *Po Wu Hui Pien* (博物彙編), *Ts'ao Muh Tien* (草木典), section 273 (第二百七十三卷), *Li Chih Pu 2* (荔枝部二), page 5 (第五頁).

³ Higgins, J. E., *The Litchi in Hawaii*, Hawaii Agricultural Experiment Station, Bulletin no. 44, pages 14 and 15.

The Chinese make a wine of the lychee which is considered a very great delicacy.

Medicinal Value

The Chinese have long recognized the curative value of the lychee and the lungan for certain ailments but also report that the raw fruit if taken in excess produce boils and other ailments. Some work has been done on the chemical analysis of the dried lychee and lungan (See Appendix) which should assist in arriving at more accurate information of the real medicinal and food value of these fruits. More work should still be done along this line. One of the most recent articles written on this interesting and important phase of the lychee has been that of B. E. Read,¹ who first quotes G. Stuart's *Chinese Materia Medica* as follows:

"... The fruits are dried in the sun or by artificial heat, and are used as sweetmeat at feasts, and often given as presents to the newly married. They are not regarded as entirely without deleterious properties, and when the raw fruits are partaken of freely they are said to produce feverishness and nosebleed. Partaken of in small quantity or in the dried form they are thirst relieving and beneficial to nutrition. But they are specially recommended in all forms of gland enlargements and tumors. The seeds are regarded as anodyne and are prescribed in various neuralgic disorders and in orchitis. The leathery external tegument of the fruits is used in decoction in the distress caused by small-pox eruption, and also in fluxes from the bowels. The flowers, bark and root are employed in decoction in angina and quinsy."

A summary of Mr. Read's¹ observations on the value of the lychee as a drug, in his own words is:

"*Therapeutic Activity.* The diseases mentioned suggest the possible presence of iodides, alkaloids or a bitter substance of strong therapeutic action. The mention of feverishness and nosebleed produced when the nuts are freely partaken of, together with the fact that this plant is a member of the soapwort family would point to the presence of saponin. No iodine was found present to account for its alleged action on tumors and gland enlargements, such as present-day treatment for goitre would suggest, and no saponin or similarly active substance was detected to account for its [supposed

¹ Read, B. E., *The Edible Litchi Nut (Litchi Chinensis)* in Journal American Chemical Society, v. 40 no. 5, page 818 (May 1918).

toxicity. When added to the regular diet of a rabbit, for a long period or when fed in as large a quantity as 50 g. at one time, no toxic effects whatever from the nuts were observed."

A more thorough study of the comparative medicinal values of the lychee and lungan should be made at an early date. Dried lungan from which skin and seed have been removed can be purchased in Chinese medicine shops and as such is an article of commerce. In the *Bulletin of Miscellaneous Information* of the Royal Gardens at Kew¹ attention was called to this lungan pulp in the following words:

"Mr. Consul Kenny in his Report on the Trade of Tainan, Formosa, for the year 1896 (Foreign Office Report, Annual Series, No. 2,021) draws attention to this substance in the following words:—"Lungan is the fruit popularly known as the 'dragon's eye.' It is prepared in the form of pulp by peeling and stoning the fruit and drying and baking it, and is used by the Chinese as tea....." Notes from a memorandum on the subject by Rev. William Campbell, F.R.G.S., Presbyterian Missionary at Tainan, are quoted in this report as follows:

"The dried Lung-ngan or Geng-geng, which is largely exported from An-peng, port of Tainan, is described as the longan fruit (*Nephelium longana*).

"Natives state that the "lichi" (*Nephelium Litchi*, Cambess.) is not very common in Formosa. It is larger than the lungan or geng-geng, has a thinner and much rougher outside husk, and contains more edible matter.

"The country of Kagi is a region where much of the geng-geng yearly production is prepared for exportation.

"The work of first heating the fruit so as to cause the soft part inside to shrink, of peeling the husk, and then of drying the abstracted soft part over a slow fire, is carried on chiefly by women and girls, who earn each about 60-80 cash (6-8 cents a day), besides getting the husks and hard inner nut for use as fuel. The work usually begins about the middle of the eighth month and lasts on until the end of the year. The dried article of export is taken to Shanghai, &c, and is said to be largely used for infusion with water as a refreshing drink or febrifuge.

¹ Kew Royal Gardens, *Bulletin of Miscellaneous Information*, Printed for His Majesty's stationery office, London, 1899, pages 219 and 220.

"Lungan pulp consists of the fleshy arillus which surrounds the seed; it is of a black color and leathery consistency and has a sweetish smoky flavour and is of an uninviting appearance."

Dried Lychee

The most common method of preserving the lychee and the lungan is to dry them. This is done either in the sun or in ovens, the former preferable if the weather permits. Many of the dried lychee for local consumption and export are produced in the Lokang (嘉興) region. In this section the only varieties that are dried are Shan chih (Shan chi 山枝), San yueh hung (Sam ut hung 三月紅), Huai chih (Wai chi 淮枝) and No mi ts'z (No mai t'sz 糯米糍) with great preference for the latter. The Chinese of Lokang (嘉興) say that no other varieties are dried because of the thin skin which makes it impossible for them to be dried satisfactorily.

There are two common methods of drying the lychee; one by sun and one by fire. The fruits are *cut off* from the trees with some stems and leaves attached. Fruits, stems and leaves are then spread out on a drying floor or placed on the ground in round, bamboo trays and exposed to intense sunlight until the skin (now almost a shell) is brittle and the aril is free and rattles in the shell. The fruits are then cut off from the stems and further dried in the sun. When they are considered sufficiently dry they are placed in the open air for one night and the dew is allowed to fall on them. The following day they are again dried in the sun until the shriveled seed becomes very dry. The fruits are then placed in wooden tubs or earthen jars which are sealed with paper and stored away. Care must be taken not to place these jars or tubs in contact with the ground lest the dried fruit absorb some moisture. Before the fruits are taken to the market and sold they are once more spread out on trays and exposed to the air and dew for one night. The following day they are dried in sunlight for several hours and then sold. Dried lychee for home consumption are rarely given this night processing as the Chinese say there are just as good; but the flesh is black instead of an attractive brown color. If care is not taken in the drying process and the lychee are exposed to rainfall the shell turns black and the fruit is spoiled.

Lychee are never dried in the ovens unless weather conditions are unfavorable for sun drying. If the days are rainy when the fruit should be dried, stoves are constructed in the homes or in convenient places. Racks made of bamboo are built over these stoves and the

fruit is dried by means of fire. The round, bamboo trays commonly in use in Chinese villages for drying purposes are about 3 feet in diameter. Square ovens of clay are first constructed. These are two or three feet high and within is placed the Chinese earthen charcoal stove known as feng lu (fung lo 風爐). Over this stove is placed an iron tray and the bamboo frame for holding the trays is built to cover the entire outfit. Seven or eight trays with lychee are then placed over the stove, one above the other, and about three or four inches apart. A bamboo cover is placed over the top of the stove. The trays are constantly shifted so that no one tray is next to the fire or occupies the same position for any great length of time. The bottom tray must be at a distance of at least one and one-half feet from the fire. If the heat is too intense the lychee will turn black.

The following table indicates the yield of dried lychee secured from the fresh as given by the people of Lokang (羅岡):

	Fresh	Dried
No mi ts'z (No mai t'sz 糯米羹)	100 catties	24-26 catties
San yueh hung (Sam ut hung 三月紅)	100 ,,	30 catties
Shan chih (Shan chi 山枝)	100 ,,	30 ,,
Huai chih (Wai chi 淮枝)	100 ,,	30 ,,

The villagers of Lokang (羅岡) sell their dried fruit to jobbers or exporters who in turn pack it in neat packages or sell it by the catty. In Canton the average price for the No mi ts'z (糯米羹) variety, other than in exceptional years, is from 60-80 cents Canton currency per catty. In the United States these same lychee appear neatly packed in pasteboard boxes and bring in the Chinese restaurants from \$1.75 to \$2.00 United States currency per pound. These modern containers in which the lychee is presented to the foreign trade, gaudily printed in no less than twelve colors with birds, beasts, insects, fruits, flowers and women, convinces one that the Chinese are learning modern methods of presenting their products in an attractive style. Across the face of the container of one company there is a Chinese gateway at the top of which are the American and Chinese flags partly hid by a scroll, upon which are the Chinese characters advertising the product contained therein.

Canned Lychee and Lungan

In recent years lychee and lungan canned in sugared syrup have been making inroads upon the home and foreign markets and their popularity is rapidly increasing. Most of the canning factories of South China are now canning this product.

Food Value of the Lychee

That the lychee and lungan as fresh, canned or dried fruit have a great future is indicated not only by its popularity among the Chinese, but also by its increasing popularity as a sweetmeat in western countries. Conclusions drawn by B.E. Read¹ indicate that the lychee makes a good supplementary food, that its calorific value is exceedingly high and that jellies made of this fruit might be of value in special diets. He says:

“*Food Value*—The proximate composition of the litchi has been estimated by Atwater and Bryant. Like the chestnut it is practically fat free, contains little, if any, protein, and consists very largely of fiber and nitrogen free extract.’ The latter was found to be composed almost entirely of simple sugars, which accounts for the inclusion of these nuts as a food and for the claim that they are ‘beneficial to nutrition.’

“The various extracts prepared were acid, and showed the presence of citric acid with possible traces of the other common fruit acids, which stimulate the appetite and are well known as ‘thirst relieving substances.’ There was no pectin body present; but this fruit with its high sugar and acid content on the addition of orange fruit would form an excellent jelly suitable for nephritic and other limited diets, required for diminishing the acidity of the urine.

“It is reported by Street that owing to its high carbohydrate content 7 g. of litchi are of equivalent calorific value to 10 g. of wheat bread. No other of the many fresh fruits or nuts cited by him show as high a value. I have found the carbohydrate to be a mixture of simple sugars chiefly invert sugar, a carbohydrate easily digested with all its energy available for use in the body.

¹ Read, B.E., *The Edible Litchi Nut (Litchi Chinensis)* in *Journal American Chemical Society*, v. 40 no. 5, May, 1918, pages 818 and 819.

“Examination of the ash showed considerable content of the mineral salts needed in a well-balanced diet; thus the nut would make a good supplement to foods rich in protein and those lacking in mineral matter.

“The many valuable suggestions of Langworthy on the use of fruit as a food could be applied to the canning, preserving, drying and general preparation of this fruit as a wholesome, palatable and attractive addition to the diet.”

At present only a very small percentage of the lychee crop is dried and canned and it is very difficult to know what the total production of the crop in China would be. No other country, except some parts of India, has developed the lychee to the industry stage.

Export

Former Vice Consul Josselyn of Canton, in the U.S. Commerce Reports of September 24, 1915, gives the approximate production of lychee in Kwangtung province alone as 20,000,000 to 30,000,000 lbs.. This report also contains Chinese Maritime Customs statistics on the export of dried lychee as follows:

	lbs.	Value U.S. Gold
Canton	862,533	\$ 148,937
Kowloon	1,051,333	181,627
Hoihow	412,400	7,522
Pakhoi	842	39
Samshui	360	66
	<u>2,327,468</u>	<u>\$ 338,191</u>

CHAPTER XII

ENEMIES

Chinese writers very rarely refer to insect enemies and diseases of the lychee. Their category of enemies consists of negligent husbandmen, frost and snow, unfavorable winds, salt water, bats and one insect which anyone who has seen the lychee crop in China will at once recognize, by sight and smell, as a very conspicuous Chinese relative of our numerous so-called "stink bugs." With the exception of tobacco stems soaked in water, which they use freely on many crops, the Chinese know very little about insecticides; of the use of fungicides they know practically nothing. Their belief in a "hand to hand" warfare is encouraged by cheap labor and they use some ingenious methods (fig. 41).

A Highly Decorated Pentatomidae—Tessaratoma papillosa

The most common insect attacking the lychee is this species known among the Chinese farmers as Ch'ou p'i tan (Ch'au p'i tan 臭屁蛋). The insect is highly destructive and Chinese farmers suffer greatly from its ravages. In the illustration (fig. 42) adults and young are represented life size. The eggs are laid in rows on the undersurface of the leaves as shown in the illustration. The backs of the insects are decorated with bands, stripes and margins of red and yellow making them very difficult to distinguish on the highly colored fruit. Mr. C. W. Howard of the Canton Christian College reports that the nymphs require about two months to mature and that there seems to be a great difference in the life histories of individuals. He says, "A few may mature in 4-6 weeks and others 8 weeks. Few eggs are seen after June but eggs and nymphs are sometimes found even in late summer. There seems to be only one generation each year although closer study may change our ideas on this." The Chinese recognize that unless these insects are kept under control they do great damage to the crop. A brown discoloration of the skin and a rotting of the flesh seems to take place at the spot where these insects rest on the fruit. The common theory of the Chinese is that the urine excreted by these insects causes this discoloration and decay; and the disagreeable odor has given it its Chinese name. The noxious odor of these



FIGURE 42.—Serious Insect Enemy of the Lychee, *Tessoratoma papillosa*.



FIGURE 41.—Killing Lychee Tree Borers with "Hisser" Firecrackers.



FIGURE 43.—Trunk of Lychee Tree Covered with Lichens and Track of Borer.

insects exudes from the openings on the back of the abdomen in the nymph stage and from the under side after the adult winged stage is reached. Mr. Howard says; "I would incline to think that injury is caused by punctures and not by the secretion of these glands as their contents are discharged only when disturbed by man or enemies. They have no urine and excreta from digestive tract is hard." There can be no question that one of the greatest pests of the lychee is this insect and the Chinese combat it as best they can by climbing the trees and scooping the adults and nymphs in by means of nets or picking them by hand. Modern methods for fighting this enemy will be watched by the Chinese with great interest. They will be ready to adopt such methods as soon as shown they are more economical than their present hand warfare.

Some Scarabaeidae—Injurious Leaf Chafers

Growers of up-land lychee experience considerable trouble with several species of *Scarabaeidae* which they call *Huang ch'ung* (*Wong ch'ung* 黃虫). These appear in great swarms in the month of April, just about the time the flower buds of the lychee open. In South China hundreds of acres of rolling land are devoted to graves, upon which the Chinese graze their cattle. This sod provides an ideal home for the larvae of these insects and in the spring myriads of adults emerge and attack the leaves and flower buds of many trees. The chief remedial measure of the Chinese is to attack these insects in the adult stage. They go out with torches and pick them from the trees. At the Canton Christian College the people pick them by hand, the agricultural department purchasing them by weight and using them for chicken food. These insects are only troublesome on the higher areas and are not a factor for consideration where trees are grown under wet conditions at any considerable distance from sod land.

Mr. C. W. Howard reports the most common species found about Canton in the order of their importance:

Hoplosternus chinensis Guer.

Holotrichia plumbica planicollis Burm.

Anomala varicator Gyll.

Adorectus convexus Burm.

Autoserica nigrorubra Busk.

postvillanus. In its immunity to the Mediterranean fruit fly Mr. Higgins classifies the lychee with the banana and pineapple.

In addition to insect enemies bats often attack the trees when the fruit is about ripe. In China these are driven off by means of gongs sounded in the trees during the early hours of the evening or by means of nets erected about the trees (fig. 21).

Fungi

Minor, superficial fungi can be found on the leaves of lychee and lungan but in general the thick, tough, glossy nature of the leaves makes their susceptibility to fungi very slight indeed. Mr. Otto A. Reinking¹ reports undetermined leaf spots and says. "The lychee tree is remarkably free from all injurious fungus attacks. The tree apparently is very healthy, with waxy, resistant leaves and a healthy bark. A black superficial leaf mold caused by a fungus of the *Meliola* or *Capnodium* type is present, but never in a serious form. Minute black specks of a fungus of the *Micropeltis* form may also be observed."

Lichens and Algae

Lichens are very common on the trunks of lychee trees (fig. 43). There are a number of undetermined species of both lichens and algae appearing on the trunk, branches and even the leaves of these trees.

¹ Reinking, Otto A., *Diseases of Economic Plants in Southern China*, The Philippine Agriculturist, Vol. VIII, No. 4, (Nov. 1919), Page 123.

CHAPTER XIII

VARIETIES OF THE LYCHEE

A fair indication of the interest and attention which the Chinese have given the lychee is manifested in the great number of varieties one finds listed in the literature of China and in the careful classification of the fruit on the markets of the country. The varieties are far too numerous for commercial culture, but a standardization has not been developed, due chiefly to the lack of intercourse between sections producing this fruit and of organization among nurserymen and growers. The varieties also run to grades which the wholesale markets are quick to recognize, often to the disadvantage of the grower. Numerous Chinese writers have carefully listed these varieties.

Writers from Fukien, and they have been by far the greater, have striven to prove that Fukien produces the best lychee, but those describing Kwangtung varieties just as strongly assert that this section produces the best. Residents of the two provinces are to-day equally as emphatic in their claims for the home-grown product. Wu Ying K'uei¹ in his *Ling Nan Li Chih P'u* tried to settle the argument interestingly by asserting that the Emperor Han Wu Ti (漢武帝), when he wished to transport lychee to Ch'ang An (長安), took all from "Chiao Chou" (Cochin China). He also proved his claim in favor of Kwangtung by showing that in the time of the T'ang dynasty, T'ien Pao (天寶), the queen, was very fond of lychee. If secured from Szechwan or Fukien the way would have been much nearer, but instead "flying riders" were provided and the "Nan Hai" (南海) district in Kwangtung provided the Queen with the best in the land. She did not get any from Fukien. On the other hand the Pen Ts'ao Tu Ching (本草圖經), as pointed out in the Annals of Fukien, places Fukien first, Szechwan second, and Ling Nan last. But as a matter of fact Szechwan hardly deserves to be ranked as a lychee producing province.

¹ WU YING K'UEI (吳應達), *Ling Nan Li Chih P'u* (嶺南荔枝譜) in *Ling Nan I Shu* (嶺南遺書), Book 59 (五十九本), section 5 (卷五), page 1 and 2 (一頁及二頁).

As early as 1492 in the Annals of Fukien there was published a list of 40 varieties at the head of which are the names of the three sent as a contribution to the Emperor. These three and 30 following are apparently those which this writer wishes to designate the "water lychee" and the best general type; for at the end of the list he names 7 varieties which he calls the "mountain lychee", the first three of which he has classified as "medium" quality. Ts'ai Hsiang in his *Li Chih P'u* lists 12 varieties under what he calls the "Chen family purple" class and 20 under the *Hu pi* (虎皮) or "tiger skin" class. In writing of these 32 varieties Ts'ai Hsiang says, "..... Those which are named after the families which produce them are the best known. When the name of a locality is mentioned in the description of a variety, it indicates that it is a variety peculiar to that particular place. Those varieties which are not named after families, and no particular place of production is mentioned, probably grow in all four places Foochow (福州), Chuanchow (泉州), Hinghwa (興化), and Changchow (漳州)—prefectures of Fukien."

Sung Yu (宋珏)¹ in his *Li Chih P'u* names 22 kinds of lychee growing in the Kwang provinces that Cheng Hsiung (鄭熊) has previously recorded, while in the Annals of Kwangtung there are listed about 30 varieties and Wu Ying K'uei² in his *Ling Nan Li Chih P'u* lists more than 70 varieties. Most of these he carefully describes, states the chief districts in which they are grown and gives the history of their origin. A list of his "Ling Nan" varieties is also appended. Mr. F. D. Cheshire, formerly U. S. Consul at Canton, in a report on the lychee published in *Plant Immigrants*, a multigraphed bulletin issued by the Office of Foreign Seed and Plant Introduction, and quoted in the *Litchi in Hawaii*, briefly described 15 Kwangtung varieties.

The Chinese of Kwangtung say that the lychee has more varieties than any other fruit. This they believe to be due to the tendency of the lychee to change its qualities under different cultural

¹ SUNG YU (宋珏), *Li Chih P'u* (荔枝譜) in *Ku Chin Tu Shu Chi Cheng* (古今圖書集成), *Po Wu Hui Pien* (博物彙編), *Ts'ao Muh Tien* (草木典), section 273 (第二百七十三卷), *Li Chih Pu* 1 (荔枝部一), page 8 (第八頁).

² WU YING K'UEI (吳應達), *Ling Nan Li Chih P'u* (嶺南荔枝譜) in *Ling Nan I Shue* (嶺南遺書), book 59 (五十九本), section 4 (第四卷), page 1-10 (一至十頁).

and soil conditions. They recognize the extreme difficulty to perpetuate the desirable characteristics of highly prized varieties under conditions other than those in which the fruit has had its origin. At the present time it is quite easy to list as many as 40 or 50 varieties of lychee recognized in Kwangtung. A list of 49 varieties in Chinese character, Mandarin and Cantonese romanization, and with English equivalents will be found in the Appendix. But 15 distinct, widely-known and commercial varieties is a fair estimate for Kwangtung. More than half of these are readily found in season on the markets of Canton city where they are attractively displayed to a discriminating public.

From close contact with the people of Kwangtung I am led to believe that there is greater intelligence on the part of the average Cantonese with regard to the names of the varieties of the lychee, and their respective good and bad qualities, than there is on the part of the average citizen of the West with regard to varieties of important fruits. The average Cantonese student or peasant will quickly tell you why he considers the No mi ts'z (No mai t'sz 糯米糍) better than the Huai chih (Wai chi 淮枝) or the Kuei wei (Kwai mi 桂味) better than the Hei yeh (Hak ip 黑葉). In South China few Chinese feasts are complete unless they are begun or finished with the lychee, dried or fresh. And when the fruit is in season the conversation of the feasters often turns to the quality of different lychee, or to a gamble as to the size of the seed in the fruit about to be opened.

Among the fifteen common varieties of lychee in Kwangtung there is a wide range with regard to earliness, general attractiveness, sweetness and size of fruit. The color and surface texture of the skin, the texture, taste and fragrance of the flesh and the size of the seed are all qualities which soon determine in the mind of the consumer the value of a variety. By judicious selection and careful propagation by experts these varieties have been *fixed*. The cultural requirements for the different varieties, though not known by the average farmer, are recognized by specialists who are engaged in the nursery business and who are quick to recommend to the grower, varieties which may be best adapted to his conditions. In this connection it is a significant fact that one of the common general classifications of varieties is the *mountain* and the *water* types, the latter containing by far the most.

In the following description of these varieties it has been difficult to carry out, with any degree of clearness to those unacquainted with this fruit, distinguishing characteristics. The Chinese in their remarks concerning the different qualities of the lychee are very *clear cut* in their terminology, much of which is difficult to translate into good English.

The *form* of the lychee they speak of as *round*, *egg-shaped* or *heart-shaped*. In describing the fruit in more detail they refer to the base as the *ti* (*tai* 底) and to the calyx end as the *ting* (*teng* 頂) or *top*. They also speak of the *shoulders* which they term *liang chien* (*lung kin* 兩肩). These they say are *high* or *low* or one higher than the other. The terms used in describing the *size* of the fruits are much the same as in English. The Chinese have many words to describe *color* but that of the lychee is usually referred to as *red* or *green red*. They refer to the *skin*, which they speak of as *k'o* (*hok* 殼) or *shell*, as *thick* or *thin*, *rough* or *smooth*. The markings or *dots* on the lychee are quite characteristic and for these they have a special term, the *chu li* (*chu tai* 蛇響). They are also quick to recognize any special lines on the fruits whereby varieties may be distinguished.

The *flesh* of the fruit the Chinese refer to as *jou* (*yuk* 肉) or *meat* and they speak of it as *poh* (*pok* 薄) *thin* or *heu* (*hou* 厚) *thick*. They recognize at once a difference of color in the flesh and are quick to describe it. They speak of the flesh as *shwang* (*shong* 爽) meaning *crisp* or *kan shwang* (*kon shong* 乾爽) meaning *dry and crisp*. With reference to the *juice* contained within the lychee they recognize that in some varieties it is more readily held within the flesh than in others. That is, when the skin of some varieties is removed, the juice of the aril remains entirely within the flesh whereas in other varieties the juice tends to run out into the skin or shell as it does in some grapes. The Chinese term covering this quality is *kan chieh* (*kon kit* 乾潔) which literally means "dry and clean;" and of the many different characteristics of the lychee, this is one of the most highly prized by the Chinese. These juices they speak of as "water" which they say is "much" or "little." The Chinese also have a term to cover that part of the fruit which we speak of as the *rag*. This they call *cha* (*渣*) which they say is "much" or "little" and which largely determines the quality of the fruit. It is the small amount of rag which gives the lychee its superiority over the more tropical rambutan.

There is a wide range of flavor in the different varieties of lychee and the Chinese have some interesting expressions to cover this quality. For example *suan* (sun 酸) is a sour acid flavor whereas *suan t'ien* (sun t'im 酸甜) or *sour-sweet* is a mild sub-acid flavor. The terms *ch'ing t'ien* (ts'ing t'im 清甜) clear sweetness and *cho t'ien* (chuk t'im 濁甜) or *dull sweetness* are often used. Sometimes they also use *hsiang t'ien* (hung t'im 香甜) meaning *fragrant sweetness* and *mi t'ien* (mat t'im 蜜甜) meaning "honey sweetness" in describing the flavor of the lychee.

The seeds of this fruit are of two chief kinds: the mature, well-developed ones which the Chinese call *ta ho* (*tai hat* 大核) or *big seed* and the shrivelled, immature ones which they call *chiao ho* (*tsiu hat* 焦核) which literally means *scorched seed*.

The following descriptions of some of the varieties of the lychee are listed here somewhat in the order of their importance as commercial fruits or in propagation.

No mi ts'z (*No mai t'sz* 糯米糍)—*Glutinous rice*

The *No mi* (糯米) or glutinous rice, characterized by its sticky or glutinous quality, is one of the most common and highly prized varieties of rice in China. A great quantity of the Chinese rice wine is made from this kind of rice. Why the Chinese should name one of their best lychee after this rice I have never heard explained. The *No mi ts'z* (糯米糍) is sometime called *Shui ching hwan* (*Shui tsing un* 水晶丸) which must not be confused with *Shui ching ch'iu* (*Shui tsing k'au* 水晶球), a distinct variety. Most of the *No mi ts'z* (*No mai t'sz* 糯米糍), also sometimes written 糯米糍, are produced in the district of Pan yu (P'un U 番禺). The Lo kang (龍岡) region is especially famous for its production of a superior type. This variety is commonly propagated by Chinese air-layering but the quality of the fruit thus produced (fig. 44) is not considered to be so good as those which have been inarched or grafted on the "mountain lychee" (fig. 45). This practice, widely followed at Lo kang, doubtless accounts for the superior fruit produced there.

The leaves of trees of this variety are rather small and do not form a very dense head. The leaflets are quite long, pointed and the margin, especially at the tip, is somewhat wavy. Petioles are short.

This variety appears on the markets rather late in the season but commands a high price and there never seems to be an over supply, probably due to the fact that an excess production is used for drying. Some people dispute the superiority of the No mi ts'z' (No mait'sz 糯米糍) over the Kuei wei (Kwai mi 桂味), which appears on the Canton markets about the same time. The fruit of the No mi ts'z' is one of the largest of any and good fruit will average about three-fourths of an ounce in weight. Good types of this variety have exceptionally small and shrivelled seeds which will not germinate. This quality doubtless places it in the first class. The form of the fruit is somewhat rounded, but with prominent shoulders (fig. 45), one of which may be somewhat higher than the other. The skin is roughened and markings prominent. The fruit is red and this color is also quite evident on the inside of the skin. The flesh is solid, crisp and of a fragrant, sweet flavor. It is so *dry* and *clean* that the Chinese remark that when the fruit is first opened the flesh can be wrapped in thin tissue paper without even moistening the paper. The flesh is very smooth and is said to resemble fat. It is one of the best varieties for drying and large quantities are thus preserved.

Kua lu (*Kwa luk* 掛綠)—*Hanging green*

If one were to consider fame this variety should certainly come first. It is the most mystical of all varieties and Chinese literature is full of interesting stories connected with it. It is produced in the hilly district of Tseng Ch'ing (Tsang shing 增城) where the original tree is still to be seen near a monastery. This tree has been described under Tseng ch'ing—the Home of a Lychee of National Fame.*

The leaves of this variety are deep green, small, narrow and quite pointed. It appears on the markets after the Huai chih (Wai chi 淮枝) but is not very commonly found on the markets of Canton. Before the time of Republic much of the fruit of this variety was sent as contribution to officials and used for presentation purposes. In those days I had one Kua lu (掛綠) presented to me in a little red box and my friend informed me that he had paid one dollar for it. I took it to an expert on the lychee who at once informed me that it could not have been from the original tree as it did not have the green tip and line characteristic of the fruits of this tree. It is this tip and line which gives the fruit the name "hanging green."

* See *supra*, chapter VII, page 50



FIGURE 45.—Natural Size and Natural Color Reproduction of the No mi ts'z—
Glutinous rice—Lychee.

70 .V90 ABSTRACT

The fruits are quite large, rough, but without prickles. The skin is thin, soft and red and said to resemble that of the No mi ts'z (糯米糍): But the seed is much larger and the sweetness of a more sprightly sub-acid flavor. The flesh is dry and crisp and like the No mi ts'z can be wrapped in tissue paper without wetting the paper. It is said to keep very well. The fruit of the original tree is noted for its medicinal qualities and for its wonderful taste and fragrance.

Kuei wei (Kwai mi 桂味)—Cinnamon flavor

The Kuei wei (桂味) is a very popular commercial variety grown largely in the Pan yu (P'un u 番禺) district, especially at Lo kang (蘿崗) and Shang yung (Sheung ch'ung 上涌). Compared with the No mi ts'z (糯米糍), the flesh of which is said to be fatty, the Chinese speak of the Kuei wei (桂味) as like lean meat. For this reason they say it can be eaten in greater quantities. In form the fruit is somewhat smaller than the No mi ts'z (糯米糍) and inclines a little more to the heart shape. It has a very rough, but pretty red skin, which tinges to green. Fruits of the Kuei wei (桂味), the skin of which is altogether red, are said to be very inferior to those with the green markings. This green color of the skin usually appears on the shoulders. These is usually a line, or constriction in the skin, running around the fruit which is quite characteristic. The roughened character of the skin, which is quite prickly, is another prominent feature of this fruit. In Lo kang (蘿崗) there is a type of Kuei wei (桂味) called the Yah t'ou lu (Ap t'au luk 鴨頭綠) which is said to be the best type of this variety. The seed of the Kuei wei (桂味) is very small and dry. The flavor is very sweet and fragrant, from which the variety doubtless gets its name of "cinnamon flavor."

Hsiang li (Heung lai 香荔)—Fragrant lychee

This variety is produced at various places in Kuang chou (Kwong chau 廣州) but the best are produced in Sin Hsing (San hing 新興) district. In fact the fruit is often called the Sin hsing hsiang li (San hing heung lai 新興香荔) to designate that it is superior to any Hsiang li (香荔) produced elsewhere. The original tree of this variety, which is said to have been the best, was located at Liu tsu fa t'ong (Luk tso fat t'ong 六祖法堂) in Sin Hsing (San hing 新興). This temple is a Buddhist temple named after Liu tsu (Luk tso 六祖), who was the sixth and last patriarch of the Buddhist Church in China. The founder of Buddhism in China was Tat-mo who came in the fourth century.

From him the headship of the Church was transmitted through a succession of patriarchs and ended at the close of the seventh century in the death of Luk-tso.¹ Luk-tso's real name was Lu Hwei-neng and his native village was Lo-ts'uen, near the present city of Sin Hsing (San hing 新興), in Kwangtung. He was born there in 625 A. D.¹ It is interesting to note that the origin of this variety has at least an indirect connection with the life of this famous Kwangtung Buddhist.

The trees of this variety are of a somewhat different appearance from those of other varieties. The tree is more upright in habit and the leaves, which are small and pointed, tend to grow upward. The fruits are small deep red in color, very rough and with many prickles, like the Kuei wei (桂味) (fig 46). The flavor is very fragrant and delicious and is said to be even better than that of the Kuei wei (桂味). The seeds of good types of this variety are smaller than those of any other variety. The Chinese say they are so small that one cannot eat sufficient fruit of this variety to fill a wine glass with the seeds.

The fruit appears on the markets rather late. Districts other than Sin hing (San hing 新興) are said to have attempted to place this variety on the markets, but these are inferior as the character of the fruit quickly changes when grown in other localities. This fact has resulted in the production of other varieties that are somewhat similar to the Hsiang li (香荔). One of these, a very small fruit a little longer in form than the Hsiang li (香荔), is a variety known as Lung ya li (Lung nga lai 龍牙荔) or "Dragon tooth lychee."

Hsi chio tsu (Sai kok tsz 犀角子)—Rhinoceros horn

This variety also had its origin is Tseng ch'ing (Tsang shing 增城). One immense tree, which is said to be one of the original trees, is still growing at Liao ts'un (Liu ts'un 廖村) and is shown in figures 47-48. In this district the fame of this variety is next to that of the Kua lu (掛綠)

The fruit is large, fragrant and sweet and the flesh is somewhat fibrous and tough. It is a very early variety, in this respect ranking ahead of Ta tsao (Tai tso 大造) which follows it. The trees are said to grow larger than those of Ta tsao (大造), and are not

¹ Henry, B. C., *Ling-Nam or Interior Views of Southern China*, S.W. Partridge and Co., London, 1886, page 224.



FIGURE 47.—Original Parent Tree of Hsi chio tsu—Rhinceros horn—Variety.



FIGURE 48.—An Immense Lychee—Rhinceros horn—Tree with Trunk Twelve Feet in Circumference.

PLATE XXXV



FIGURE 49.—Hei yeh—Black leaf—Lychee.
One-half natural size.)



FIGURE 50.—Fei tsu hsiao—Imperial concubine laugh.
One-half natural size.)

so compactly headed as those of the latter. The trunk and branches are very irregular the leaves are not dark in color. The fruits are quite large, full at the top and sharp at the bottom, giving it the appearance, it is said, of a rhinoceros horn. The seeds also are wide at the top and narrow at the bottom and the skin is quite rough.

Hei yeh (Hak ip 黑葉)—Black leaf

The Hei yeh (黑葉) is one of the most widely known and popular varieties in Kwangtung. It is widely planted, but certain places are known to produce fruits of the better types. In the district of Shun te (Shun tak 順德), village of Ch'en ts'un (Ch'an ts'un 陳村), there is a variety called the Chin ch'ai tzu (Kam ch'ai tsz 金欖子) the fruit of which, in shape and color, somewhat resembles that of Hei yeh (黑葉). The fruit has small seeds and sweet taste and is sometimes called Hei yeh (黑葉).

A characteristic feature of the Hei yeh (黑葉) is the color of the leaves which are very dark and from which the variety gets the name "Black leaf." The leaves are long and wide, pointed and slightly curled. The tree is densely covered with them. The petioles are quite long.

The fruit ripens in June and July, the season in which the best lychee appear, and appears after T'ang po (T'ong pok 塘壩). Those ripening in the Chinese season known as Hsia chih (Ha chi 夏至) are said to be the best and true type. It is a medium sized fruit with thin, soft skin (fig. 49). The shoulders are wide. The color is not so red as many varieties and somewhat green tinted. The seed is usually fully developed, of good size, and readily germinates. The inside of the skin and sometimes the flesh is slightly pink. The flesh is sweet and crisp.

This variety is said to be one of the best of the "water lychee", but it is also recommended for upland conditions if sufficient water for irrigation is assured. It is a beautiful tree and quite widely used as an ornamental.

Fei tsu hsiao (Fi tsz siu 妃子笑)—Imperial concubine's laugh

This interesting variety had its origin in Fatshan (佛山), an important delta city near Canton. The fruits of this variety appearing on the markets are produced in Pan yu (P'un u 番禺) district. The color of this fruit is described as that of amber; the size and

shape that of a goose egg and the sweetness of honey. The skin is thin, the meat is thick and the seed is very small. The juice is somewhat milky. The flavor is very fragrant and is said to remove any bad odors from the mouth and to give the teeth a fragrance which will last over night. In general appearance the fruits produced at the present time are said to resemble those from the original tree except that the form is somewhat more elongated and the skin more dotted. The seeds are sometimes large and sometimes very small (fig. 50). It is an early ripening variety appearing shortly after San yueh hung (Sam ut hung 三月紅).

T'ang Po (T'ong pok 塘學)—*Pond embankment*.

This is another very early variety widely planted throughout Kwangtung. In Pan yu (P'un u 番禺) district it will be found at Pei shan (Pak shan 北山), Lun t'ou (Lun t'au 嶺頭), T'u hua (T'o wa 土華) and Li chiao (Lik kau 濠落). It ripens about ten days after San yueh hung (Sam ut hung 三月紅).

The leaves are small and somewhat like those of the Huai chih (Wai chi 淮枝). The fruit is said to resemble the egg of a pigeon. The skin is red and roughened. The flesh is thin and juicy and with little rag. The flavor is quite sour.

Shang hou huai (Sheung shu wai 尙書懷)—“*President of a board embraces*”

This variety probably has its origin in Fukien as it is reported that an official known by the title of Shang shou (尙書) i.e., a President of a Board, went from Kwangtung to a place in Fukien and brought back with him seed of a fruit the tree of which gave origin to this variety.

The fruit ripens about the same time as the No mi ts'z (糯米糍) and is quite widely grown in Kwangtung. The leaves are quite small. The fruit is large and rounded in form. The skin is red with many large dense spots. The inner part of the skin is pink and adheres slightly to the upper part of the seed. The flesh is quite easily separated from the seed and the flavor is sweet but with little fragrance. The seeds vary in size.



FIGURE 51.—Ch'u ma tsu—China grass fiber—Lychee.
(One-half natural size.)



葉黑

FIGURE 52.—The Huai chih Lychee Labeled Hei yeh—
Black leaf.

Three-fourths natural size.



FIGURE 53.—The San yueh hung—Third month red—
Lychee.
(Two-thirds natural size.)



FIGURE 54.—Large-seeded Shan chih—Mountain Lychee.
Used for Stock for Grafting.
(About one-third natural size)

Ch'u ma tsu (Chu ma tsz 苧麻子)—China grass fiber.

This variety is produced in Lo kang (Lo kong 羅岡) and ripens shortly after Kuei wei (Kwai mi 桂味). The leaves are quite large and densely crowded on the tree, tending to fold over one another and hang downward. The petioles are long.

The fruits are quite large and said to be shaped like a thumb or chicken heart. The shoulders are quite high up. The skin is rough, but the markings large and few (fig. 51). The inner skin is very red. The flesh is quite dry and crisp and tends to stick to the seed which may be large or small. It is considered to be a very fragrant variety, but not of especially fine flavor.

Ta tsao (Tai tso 大造)—Large crop

This is a very commonly grown variety, widely scattered over many of the districts bordering Canton. It ripens quite early appearing after Hei yeh (Hak ip 黑葉). The fruit is somewhat egg-shaped with rough skin and many dots, which are dense and small. The skin is a bright red. The flesh is quite solid and crisp, but with lines of yellow color especially near the seed which is large. Some of the juices run out into the skin upon opening. The flavor is rather sweet.

Huai chih (Wai chi 淮枝)—The Wai River lychee

This is perhaps the most common variety and the cheapest. It ripens quite late in the season for the best flavored lychee, but its very large seed and watery nature place it in a somewhat inferior class.

The leaves are medium large and not pointed. The form of the fruit is quite round. The skin is of medium smoothness; not nearly so smooth as the Hei yeh (黑葉). The dots or markings are few and small. In general appearance it much resembles the Hei yeh (黑葉) and the best types of this variety are often sold for Hei yeh (黑葉) (fig. 52). The color of the skin is a good red and inside the skin is pink. Seeds of this variety germinate readily and it is a vigorous grower, very easily propagated and cultured. It is said to be one of the most satisfactory general purpose varieties as it is a high yielder and has a long season.

San yuck hung (*Sam ut hung* 三月紅)—“Third month red”

This is the earliest maturing lychee produced in Kwangtung. It appears on the markets in early May and finds a ready sale in spite of its inferior quality compared with lychee produced later. A village by the name of Ma yuen (Ma un 麻園) in Sunwui (新會) district is very famous for its production of this variety. At this place the fruit is known under the name of Tsao kuo (Tso kwo 早果), meaning “early fruit.” It is also sometimes called Tsao li (Tso lai 早荔) or “early lychee.” It is grown chiefly along the dykes and is quite readily distinguished from other varieties. The variety is said to have originated in the Heungshan (香山) district near the village of Sha yung (Sha ch’ung 沙涌). A Sung dynasty emperor is reported to have visited this village, stopping with a family by the name of Ma (馬). The emperor was very fond of lychee, but as it was early summer not any of the fruit had ripened. But strangely it was found that fruit from some trees had ripened and thus the variety was originated.

The leaves of this variety are quite long and pointed and much thicker than other varieties. The branches of tree are said to be very brittle and easily broken off. The fruit is exceptionally large, averaging over an ounce in weight (fig. 33). The skin is thick and tough with few but large markings. The fruit is red but not brilliantly so. The flesh is quite thick, not very sweet and with much rag. The seeds are long and not matured.

Pai la li chih (*Pak lap lai chi* 白臘荔枝)—White wax lychee.

This fruit is also known under the name of Po le tzu (Pak lik tsz 白荔子, —white fragrant plant. The fruit is quite common in the Heungshan (香山) district and ripens after the Huai chih (Wai chi 淮枝). The fruit is large and rounded with pink rough skin and many large dots. The flesh is not particularly sweet, somewhat stringy and tending to a pink color. The seeds are usually large.

Shan chih (*Shan chi* 山枝)—Mountain lychee

This is the variety which is doubtless nearest the wild form and it is found widely scattered throughout Kwangtung. It is usually found in the hills rather than along streams. It is grown in many places and recognized as especially valuable for stock on which to grow the better varieties. It is sometimes known under the name Suan chih (Sun chi 酸枝) or “sour lychee.”

The leaves are very large, wide and quite pointed. Petioles are short. The tree is an upright grower and twigs also tend upward. It ripens very irregularly, some late and some early. The form is rather elongated with a very roughened skin and bright red color. The flesh is thin, the seed exceptionally large (fig. 54) and the juice is sour. The flavor is said to depend upon the soil and cultural methods and the Chinese believe that the character of this variety can be quickly changed under cultivation.

A number of so called varieties of lychee have originated from the Shan chih (山枝), such as for example the Mi kwei (Mai kwai 米桂), Chia huai (Ka wai 假淮), Ta niu ku (Tai ngau ku 大牛牯), Ta ch'iao ch'un (Ma tseuk ch'un 麻雀繡), Cheng pao hou (Ch'ang pau hau 撐爆喉), and Ting sz niu (Ting sz ngau 掙死牛).

One of the most interesting types of mountain lychee thus far reported is that called Yeh shan chih (Ye shan chi 野山枝) or "wild mountain lychee." This fruit has been reported as growing in the West river region. A search has been made for the tree or trees which are said to exist, but thus far without success. The fruit is said to resemble the lychee, but with hairs instead of prickles. The tree is very large and tall and the seed very light in color.

In addition to the fifteen varieties described there are many others of commercial importance or of purely local interest. The Ya niang hsieh (A neung hai 亞娘鞋) is a promising new variety coming from the Lo kang (Lo kong 嘉岡) region. It is said to rival the No mi ts'z (No mai t'sz 糯米糍) but as yet has made little progress on the Canton markets. The Pu tai (Po toi 布袋) has also originated from the same place as the Ya niang hsieh (亞娘鞋). The Chuang yuan hung (Chong un hung 狀元紅) is quite popular and can be purchased on the Canton markets (fig. 55). The Yu ho pao (Yuk ho pau 玉荷包) is a very common early variety appearing immediately after the San yueh hung (Sam ut hung 三月紅). Many claim that it is a type of Sam yueh hung (三月紅) but the evidence to hand leads us to think it is more of a distinct variety than many of the other so-called varieties.

An analytical descriptive table of some of these important lychee varieties appears on the following pages.

	No mi ts'z No mai t'sz 糯米糍	Kuei wei Kwai mi 桂味
Number of fruits	20	26
Cc. of juice	270	240
Weight of seeds (oz.)	1/2	1/2
Weight of flesh (oz.)	13	11 1/2
Weight of skin (oz.)	1 1/2	2
Weight of leaves and stem (oz.)	1	2
Weight of rag (oz.)	6 1/2	2
Longitudinal dia. (in.)	1 1/4	1 1/8
Latitudinal dia. (in.)	1 1/2	1 1/4
Longitudinal cir. (in.)	4 3/8	1 15/16
Latitudinal cir. (in.)	4 7/16	4
Seed	Small and shriveled	Small and dried
Color of Skin	Rounded with top broad	Rounder with top broad
Surface of Skin	plate 1 3. O-R b Rose Doree	plate 1 3. O-R b Rose Doree
Shape	Rough with few dots	Very rough
Juice all held within aril or some in skin upon opening	All within	All within
Flavor	Sweet, honey fragrant	Honey sweetness
Average date when the variety can usually be secured	July 8	July 8

Important Lychee Varieties

101

Hei yeh Hap ip 黑葉	Shang shou huai Sheung shu wei 尙 奇 懷	Ta tsao Tai tso 大 造	Huai chih Wai chi 淮 枝	Pai la li chih Pak lap lai chi 白 臘 荔枝
26	26	22	28	17
230	260	210	240	235
2	1	2	2	2
11	11 1/2	11 1/2	10	11
2	2 1/2	2	3	2
1	1	1/2	1	1
1 1/2	2	2 1/2	2	2 1/2
1 1/4	1 1/4	1 3/4	1 1/16	1 7/16
1 3/16	1 1/4	1 5/16	1 1/8	1 9/16
4	4 1/8	4 7/16	4	4 9/16
4	4 1/8	3 3/16	4 1/16	4 3/4
Large, oblong	Large and small	Large and small elongated	Large	Large
Rounder	Round with broadened top	Rounded with broadened top	Round	Round
plate 1 3. O-R b Rose Doree	plat 1 8. O-R Scarlet- Red	plate 1 3. O-R b Rose Doree	plate 1 3. O-R b Rose Doree	plate 1 1. Red b Begonia Rose
Rough and thin	Rough, thin	Rounded with many small dote	Quite smooth Few large dots	Smooth and thin Few small dots
All within	All within	All within	Some in skin	Some in skin
Sweet	Sweet	Sweet	Sweet	Sweet
June 18	July 8	June 29	July 15	July 24

In addition to the varieties described and those listed in Appendix IV as found in Kwangtung there are also many other varieties reported which have not as yet been studied. These include the Ch'en tzu (Ch'an tsz 陳紫)—Ch'en's purple, Li ting chu (Li ting chu 麗頂珠) i. e., pearl of a black horse's head, Mou ni kuang (Mau ni kwong 牟尼光), Shih pah niang (Shap pat neung 十八孃)—Eighteen maids, Tai hwa hsiang (Tai fa heung 戴花香)—"wearing flowery fragrance," and Chiang chun tzu (Tseung kwan tsz 將軍紫)—General's purple.

With regard to Indian varieties, Higgins¹ reports: "A variety known as 'Mclean' is said to be one of the best in that country. Another under the name 'Muzaffarpur Seedless' is practically seedless in many of its fruits, 'Bedana' is another small seeded, sweet variety. 'Dudhia' is quite unusual in that it is white. 'Rose scented' is a fruit of large size and very agreeable flavor. 'China' is a late-season variety."

¹ Higgins, J. E., *The Litchi in Hawaii*, Hawaii Agricultural Experiment Station, Bulletin No. 44, page 20.



FIGURE 55.—Chuang yuan hung—Royal red—Lychee.
(Two-thirds natural size.)



FIGURE 56.—The Yau yen Lungan as a Temple Tree.



FIGURE 57.—The Rounded Head of a Fruiting Lungan Tree.

CHAPTER XIV

THE LUNGAN

The lungan has been described as the "monk" of the sapindaceous group of fruits. A Singapore Chinese was endeavoring to make a simple but distinctive comparison of these four fruits. He said, "The *rambutan* is the long haired gentleman of the group; he has flowing locks. The *pulassan* has his hair cut modern style. The *lychee* has had the clippers put on his head. But the *lungan*, with head closely shaven, is the Buddhist priest of the four." This description applies only to the general outside appearance of these fruits with relation to length of setae or smoothness of skin. It indicates that, unlike any of the others, the outside surface of the lungan is smooth.

The lungan is the most cold-resistant fruit of the group and will be found growing farther north than the lychee, and at higher altitudes. It requires perhaps a little less care than the lychee and individual trees growing in a semi-wild condition are seen more often than lychee. It is a taller, higher-headed tree, with branches and flower spikes growing more upright than those of the lychee and with bark characteristically its own. The fruits are much smaller than lychee but the leaves and the flowers are conspicuously larger.

The fruit is round, or nearly so, and when ripe is yellow. The fruit clusters are usually much more crowded than those of the lychee. It fruits about a month later than the medium late varieties of lychee, the best varieties appearing in the month of August. It is consumed by the Chinese in considerable quantities. They believe that this fruit is not so strengthening as the lychee but prize its medicinal value very highly. The aril is certainly less fleshy than that of the lychee and much more vinous in taste. The seed is invariably large and there are no varieties with shriveled seed as in the lychee. The seed is usually black or sometimes brown and is said to look like a "dragon-eye", whence the fruit gets its name.

Chinese literature records many names for the lungan. As early as the sixteenth century Li Shih Cheng (李時珍) in his *Pen T'sao Kang Mu* (本草綱目) records a long list of synonyms. Another writer goes into quite a lengthy discussion as to whether a fruit called the I chih (Yik chi 益智) is the same as the lungan. He records that it was the belief of many people that the two were the same but his conclusion was that the two must have been quite different as the I chih (Yik chi 益智) grows on a vine whereas the lungan grows on a tree. We have not yet been able to locate the I chih (Yik chi 益智), though it is doubtless *Sapindaceae*, as some of the species of this family are vines.

The lungan is very widely cultivated in Kwangtung but from all reports to hand Fukien has made greater progress in its development. In the Ling Nan region, P'ing chou (P'ing chau 平洲), Chih kang (Ch'ik kong 赤岡), Ta t'ang (Tai t'ong 大塘) Pei shan (Pak shan 北山) and Shih wei t'ang (Shik wai t'ong 石圍塘) are especially famous for their lungan. The best variety of lungan the Shih hsia lung yen (Shek hap lung ngan 石峽龍眼), had its origin at P'ing chou (Ping chan 平洲) and the fruit of this variety produced there is said to be better than that produced at any other place. Although not so large, the flesh is more crisp, the seed is smaller and the fruit after drying, if soaked in water, freshens up almost like the fresh fruit. The fruits produced at P'ing chou (平洲) are also said to be much sweeter than those of other places.

A Suitable Dooryard and Avenue Tree

In the Ling Nan region the lungan is very frequently planted as a dooryard or village tree and a favorite site is near temples (fig. 56). Magnificent specimens such as these, which are at least forty feet high with a straight trunk five feet to the branches, would make wonderful avenue trees. The diameter of the trunk of this tree, breast high, is two feet eight inches. The rounded head of the lungan tree is well illustrated in figure 57.

Cultural Methods

Although the Chinese commonly think of the lungan as a very desirable tree for shade, its culture as a fruit is not neglected and some large lungan orchards will be seen scattered over the country. For example at Ta t'ang (Tai t'ong 大塘) in Chiao t'ang sz (Kau t'ong sz 葵塘司) the lowland regions are often planted to lungan.

Beds about 15 feet wide with trenches between of about 6 feet are often raised up as in lychee culture. Lungan trees are then planted along the edge of these beds and pumelo are planted down the center. The lungan prefers a rich, sandy loam and its roots should have access to plenty of water. At Ta t'ang (Tai t'ong 大塘) an interesting form of planting is followed, similar to that sometimes used in citrus culture. After the beds have been raised up above the incoming tides, little mounds of canal earth are built up on the beds several feet above the surface and the young trees are then planted on these mounds. Year after year as the trees grow more canal earth is carried on to the beds and the young roots are thereby nourished by this fresh, rich soil. The young trees, thus planted, are often held in place by bamboo supports and the trunks are wrapped with rice straw to prevent sun scald. When the trees are planted upon higher ground holes are dug and the soil enriched. The trees are always planted in the spring.

In order to obtain good results with lungan the Chinese recognize the importance of fertilization. The trees are fertilized after picking the fruit; once during the winter and once during the flowering season. At the latter season the Chinese recognize that it is not well to feed too much night soil or urine fertilizers high in nitrogen but that they should feed more ground bones and ash. In low-land culture it is common to take advantage of the winter months, when the waters are low, to smear fresh canal mud over the beds. The results from this rich soil are indeed gratifying.

Several interesting customs connected with the cultivation of this fruit are worthy of note. The Chinese recognize that considerable thinning of the fruit is usually necessary. It is a common practice to thin the flowers rather than the fruit. The Chinese say, "Lungan, one flower, ten fruits; lychee, ten flowers, one fruit." By this they mean to point out the importance of protecting the flowers in lychee culture and of destroying some in lungan culture. Accordingly a large number of flower-bearing twigs are pruned from the trees by the growers. Mr. W.B. Cole¹ of Hing-hua, Fukien, an important center for lungan culture, in a letter to the Office of Foreign Seed and Plant Introduction, said, "This is the flowering season of the lungan. It is also the time when the pruning is done.

¹ Cole, W. B., from Office of Foreign Seed and Plant Introduction, United States Department of Agriculture, Washington, Reports, Correspondence, etc.

About three-fourths of the spikes of the flowers are cut off. Next year's fruit comes from the new growth from these pruned branches. Later on the fruit on the bunches is thinned out. The fruit growers take infinite pains with this fruit. The trees are also fertilized at this season, with night soil as a rule. Most trees are fertilized about three times a year. . . ."

The fruit is picked in July and August, and after Li Tsiu (Lap Ts'au 立秋, about the Chinese 8th month and 8th day) it is said to be very inferior. Practically all of it is picked before that time though the Shih hsia (Shek hap 石峽) will keep a few days longer. The fruit is removed from the tree by cutting off the clusters with leaves and branches attached. The varieties of the lungan in point of earliness appear on the markets in the following order: Tsao ho (Tso wo 早禾), Wu yuan (U un 烏圓), Hua kioh (Fa hok 花殼), Shih hsia (Shek hap 石峽), and Shep'i (She. p'i 蛇皮). The trees will yield up to four or five hundred pounds of fruit. Many of the fruits are dried, preferably in the sun. As the fruiting season of the lungan is the period of Kwangtung's most severe typhoons and driving rains it is often difficult to get the lungan to the markets or to dry them satisfactorily. This is doubtless a serious check to successful lungan culture.

Methods of Propagation

Most of the lungan trees in cultivation in Kwangtung are either seedlings or have been inarched. Where inarching is practiced the stock is almost invariably Wu yuan (U un 烏圓) which is allowed to reach a height of five or six feet, requiring from three to five years, before it is inarched. The inarch is made high up on the trunk no less than four feet from the ground. This practice is doubtless followed as it is the easiest way to succeed with the inarch when the young plants are taken to the parent trees. But the point of union is at a weak place in the tree and during the high winds there is a tendency for the tree to break at this place unless carefully protected with bamboo bracing until quite old. Even in old trees it is usually possible to determine the point of union between stock and scion, as there seems to be some little difference in the rate of growth of the two and the bark of the Wu yuan (U un 烏圓) is usually rougher than that of other varieties.

Grafting the lungan is seldom practiced in Kwangtung but Wu Ying Kuei (吳應達) refers to the art as practiced on the lungan.

He calls attention to the fact that although the lungan is always grafted on its own stock it is not unusual to find three or four grafts sandwiched between the stock and the top, a practice which is said to develop a much better fruit. This sandwiching of grafts consists of top-working the lungan to the lungan, but as soon as the scion is well established it is cut off and a new graft inserted in the new growth of wood. This process is continued three or four times. Mr. Cole says: "The chief answer the Chinese fruit grower gives for this novel method of grafting is that it makes larger fruit. They also have the idea that it makes a stronger tree to withstand the wind. Typhoons are very severe along this coast. This graft provides a brace for the new graft so that it cannot be readily torn out. This region in China has the reputation for the best lungan. The fruit growers know nothing about the scientific side of the question. Their objective is large, sweet fruit. How their methods do it they do not know. But it is true that they get results. In Foochow, 75 miles to the north, where they are not so skilled, the fruit is of a decidedly inferior quality having large pit and small pulp. Here the fruit is large with small pit and thick, juicy pulp.

"They tell me that where two or three trunks are grafted into one top that the good fruit bearing wood lends its strength to the top making the entire top bear large fruit.

"They do not seem to have much success here in using the litchi for a stock on which to graft the lungan. They say that where they succeed it makes good fruit."

Varieties

There are ten or twelve varieties of the lungan with considerable range in quality and earliness. A list of these will be found in the Appendix. An analytical study of some of the best varieties is given herewith.

The Shih hsia lung yen (Shek hap lung ngan 石峽龍眼)—The Stone Gorge Lungan

This variety is considered the best of the lungan. It had its origin in P'ing chou (P'ing chau 平洲) of the Nan hai (Nam hoi 南海) district. The original parent tree is said to have grown out between two rocks, which gives the variety its name. Investigation in the region has not resulted in the location of the tree nor the rocks in which the tree is said to have grown. This variety is also known under several other names. The Shih yeh lung yen (Shap ip lung ngan 什葉龍眼) or "Ten leaf lungan" is said to be a type of this and is so-called because the leaflets are usually ten in number. In general there seems to be two distinct types of the "Stone Gorge Lungan", the black seeded type and the brown seeded type. The former is known under the name of Hei ho shih hsia (Hak hat shek hap 黑核石峽)—"The Black Seeded Stone Gorge Lungan, and the brown seeded type as the Chin ch'i ho shih hsia (Kam ts'at wat shek hap 金漆核石峽).

Wu Yuan (U un 烏圓)—Black Ball

This is a small lungan, probably nearer to the wild than any other variety, very small, quite sour, large seed but widely used for stock in the Ling Nan region. The leaves of the tree are large, bark rough and it is a vigorous grower (fig. 58). Although the fruits are small (fig. 59) they are edible and usually used for canning. The Chinese say that the sour taste of this lungan makes it better fruit for canning. The Kao yuan (Ko un 烏圓) is probably a type of this variety of somewhat superior quality. It is also widely used in canning.

Tsao ho (Tso wo 早禾)—Early Rice

This is the earliest variety of lungan and while not so good is nevertheless highly prized. There is a type of this variety about two weeks earlier and called the Ch'i chin tsao ho (Kam ts'at tso wo 金漆早禾).

She p'i lung yen (She p'i lung ngan 蛇皮龍眼)—Snake Skin Lungan

This is one of the largest of the lungans and is very late. The fruit is about the size of a small lychee (fig. 60). The skin is rough and the seed is large and the quality is considered inferior. It is produced very largely at Shih wei t'ang (Shek wai t'ong 石圍塘).

The Hua kioh (Fa hok 花殼)—Flower Skin

Most of the trees of this variety are seedlings and the Chinese recognize it as one of the poorest of the lungan. The flesh is thin and rather tasteless.

Lungan Varieties

109

Kao yuan Ko un 卓圓	She p'i lung yen She p'i lung ngan 蛇皮龍眼	Ts'ui you lung yen Ts'ui yuk lung ngan 龍肉龍眼	Shih hsia lung yen Shek hap lung ngan 石峽龍眼
82	38	62	73
100	160	110	120
5	3	4	3
6	8 1/2	7	8
3	3	3	3
2	1 1/2	2	2
3	2 1/2	3	3 1/2
7/8	1 3/16	9/16	7/8
15/16	1 1/8	1	1
2 11/16	3 5/8	2 1/8	2 3/4
2 1/4	3 5/8	3 1/4	2 7/8
Rounded	Slightly elongated	Slightly elongated	Slightly elongated
19 YO-Y Honey yellow	19 YO-Y-d Cream buff		21 O-YY Colonial buff
Rough, thick, dots close and many	Rough, thick, dots close and many	Smooth, thick, few small dots	Rough, thick, few small dots
All within	Some in skin	All within	All within
Sweet	Sweet and juicy	Sweet and refreshing	Sweet, refreshing and flesh very thick
August 5	August 16	August 5	August 10

The Shih hsia lung yen (Shek hap lung ngan 石峽龍眼)—The Stone Gorge Lungan

This variety is considered the best of the lungan. It had its origin in P'ing chou (P'ing chau 平洲) of the Nan hai (Nam hoi 南海) district. The original parent tree is said to have grown out between two rocks, which gives the variety its name. Investigation in the region has not resulted in the location of the tree nor the rocks in which the tree is said to have grown. This variety is also known under several other names. The Shih yeh lung yen (Shap ip lung ngan 什葉龍眼) or "Ten leaf lungan" is said to be a type of this and is so-called because the leaflets are usually ten in number. In general there seems to be two distinct types of the "Stone Gorge Lungan", the black seeded type and the brown seeded type. The former is known under the name of Hei ho shih hsia (Hak hat shek hap 黑核石峽)—"The Black Seeded Stone Gorge Lungan, and the brown seeded type as the Chin ch'i ho shih hsia (Kam ts'at wat shek hap 金漆核石峽).

Wu Yuan (U un 烏圓)—Black Ball

This is a small lungan, probably nearer to the wild than any other variety, very small, quite sour, large seed but widely used for stock in the Ling Nan region. The leaves of the tree are large, bark rough and it is a vigorous grower (fig. 58). Although the fruits are small (fig. 59) they are edible and usually used for canning. The Chinese say that the sour taste of this lungan makes it better fruit for canning. The Kao yuan (Ko un 烏圓) is probably a type of this variety of somewhat superior quality. It is also widely used in canning.

Tsao ho (Tso wo 早禾)—Early Rice

This is the earliest variety of lungan and while not so good is nevertheless highly prized. There is a type of this variety about two weeks earlier and called the Ch'i chin tsao ho (Kam ts'at tso wo 金漆早禾).

She p'i lung yen (She p'i lung ngan 蛇皮龍眼)—Snake Skin Lungan

This is one of the largest of the lungans and is very late. The fruit is about the size of a small lychee (fig. 60). The skin is rough and the seed is large and the quality is considered inferior. It is produced very largely at Shih wei t'ang (Shek wai t'ong 石圍塘).

The Hua kioh (Fa hok 花殼)—Flower Skin

Most of the trees of this variety are seedlings and the Chinese recognize it as one of the poorest of the lungan. The flesh is thin and rather tasteless.



FIGURE 58.—Wu yuan—Black ball—Lungan Seedling Fourteen Months Old.



FIGURE 59.—A Fruiting Cluster of Wu yuan—
Black ball—Lungan.
(Two-fifths natural size.)



FIGURE 60.—The She p'i—Snake skin—Lungan.
(Two-thirds natural size.)

CHAPTER XV

THE INTRODUCTION OF THE LYCHEE AND LUNGAN

INTO OTHER LANDS.

Roxburgh¹ states that the lychee common in Bengal was originally brought from China. India is the only country into which a successful commercial introduction has been made and Macmillan² reports: "This fruit, represented by different varieties, of varying quality, is grown to great perfection about Calcutta and elsewhere in India, and is commonly sold in the bazaars when in season." The lungan and rambutan, introduced into India in 1798, have always been carried side by side with the lychee.

Europe became interested in these fruits in the early part of the 19th Century, when effort was made to introduce them into both England and France. And it was doubtless at this time that these plants were transferred to different places in the East Indies where their culture is more promising. In the *Quarterly Journal of Science*, 1882, we find the statement: "Attempts have been made to introduce into Trinidad the litchee (*Nephelium Litchee*), and though the climate is too uniformly hot, the fruits have been delicious, resembling a high class muscat grape in consistency and flavor."

In 1903 O.F. Cook and G.N. Collins³ in their *Economic Plants of Porto Rico*, published by the United States National Museum, devoted nearly a page to *Litchi chinensis*, calling attention to it as "one of the fruits most likely to succeed in Porto Rico and likely to be of value when once generally introduced." They pointed to the scarcity of literature on the results of experiments on this tree in the West Indies and to its successful introduction into India.

¹ Roxburgh, William, *Flora India; or description of Indian plants*, 2 vol., Calcutta, 1832, Vol. 2, page 269.

² Macmillan., Hugh F., *A handbook of tropical gardening and planting*, Colombo, H. W. Cave and Co., 1910, page 177.

³ Cook, O. F., and Collins, G. N., *Economic plants of Porto Rico*. In contributions from the United States National Herbarium, Washington, D. C., 1903, Vol. 8, part 2, pages 176 and 177.

In October, 1911, a photograph was received by the Office of Foreign Seed and Plant Introduction of the United States Department of Agriculture from J. Jones, Curator of Botanic Station in Dominico, showing a fruiting branch of the lychee.

Higgins¹ is authority for the statement that the lychee was first introduced into Hawaii in 1873 by Mr. Ching Check and since that time there have been other introductions by the United States Department of Agriculture and by Chinese residents. The Hawaii Agricultural Experiment Station Annual Report, 1912, portends an increasing interest in the lychee in those islands, by the statement, "the litchi plants imported from China direct, and those received through the Office of Seed and Plant Introduction, are making a very satisfactory growth, and may be regarded as past the critical stage." Plate, II figure 2, shows a tree planted March 14, 1908.

Charles Amory at Sanford, Florida, grew specimens of this fruit as early as 1883 and Theodore L. Meade at Oviedo, Florida, had a tree in 1888. The first lychee tree introduced into California was that planted by E. D. Hadley about 1897. This was secured from Reasoner Bros. of Oneco, Florida, who had imported this tree from Seharanpur, India; and in 1913 it fruited for the first time. In 1914 Mr. Bissett and Mr. Wilson Popenoe of the Office of Foreign Seed and Plant Introduction reported the tree in fruit in October. Mr. Popenoe, who had seen fruits in the Orient, said that the fruit of this tree was smaller than that in the Orient, but that the flavor was very pleasant. Prior to 1900 there was a tree growing in the greenhouses at Washington. This flowered but never fruited.

One of the earliest introductions by the Office of Foreign Seed and Plant Introduction was in 1907, when they received a shipment of plants from China via Shanghai. Rev. W. N. Brewster, missionary at Hing-hua fu, Fukien, China, was so convinced of the future of the fruit in America that he imported living trees at his own expense and between July 1, 1907, and January 1, 1908, he sent to the Office of Foreign Seed and Plant Introduction interesting data regarding the culture of the lychee and the lungan. The photographs submitted were the first ever received by the office showing the tree in bearing. Subsequent shipments of both seeds and

¹ Higgins, J. E., *The Litchi in Hawaii*, Hawaii Agricultural Experiment Station, Bulletin No. 44, page 5.

plants were received from Samuel L. Gracey, American Consul, Foochow, and from others in China. From Java, Saharanpur and Muzofferpur plants and seeds were received. Distributions were made to Florida, Cuba, Panama, Guam, Porto Rico, Isle of Pines and Trinidad. Trees of the Shanghai shipment of 1907 sent to Reasoner Bros. of Oneco and to W. S. Taylor of Tampa, Florida, fruited in 1916, when both reported fruit to the office, those of Reasoner Bros. being first received. In 1915 Mr. John Ashon of New Orleans, La., brought with him, upon his return from China, forty trees of the very best Kwangtung varieties. These he turned over to the United States Department of Agriculture, but only a few were in a living condition.

In the summer of 1915 and 1916 large quantities of seeds were received from J. E. Higgins, Honolulu, Hawaii; from the Canton Christian College, Canton, China, and from Frank N. Meyer, Agricultural Explorer in China. Seedlings from these were grown at the government stations at Rockville, Md., Chico, Cal., and Miami, Fla. W. S. Taylor of Tampa, Florida, also received some of these and imported seeds on his own initiative. At the request of the Office of Foreign Seed and Plant Introduction, carefully chosen plants of the best varieties were introduced through the Canton Christian College in May, 1917. These were left at Honolulu in the care of Mr. Higgins, as the boat was slow and they were not enduring the rigors of the journey.

Greater success has been attained in the introduction of the lungan into Europe and the United States than has been the case with the lychee. It has fruited in both Florida and California and is listed on the catalogue of the Royal Palm Nurseries, Oneco, Florida.

Some Problems in the Introduction of These Fruits

Unusual care and attention is required in order to introduce successfully these interesting fruits into new countries. The trees of both species are very tender and especially susceptible to cold and salt air or salt water. In the transportation of selected stock only the most carefully selected position on the ship will guarantee sufficient heat and moisture to protect the trees from the blasting effects of the salt sea air. Chinese methods of propagation do not encourage strong root development and the tendency of the average shipper is to send newly layered trees, the root systems of which are not firmly established.

We have seen that unusual precautions are necessary to guarantee the successful introduction of lychee seeds and that this method offers little encouragement for the acquisition of the best varieties as seeds of these are not viable.

There are great differences in the varieties of both the lychee and the lungan and it is not easy to be sure that one has secured the best stock unless he has personally supervised the choice of the branches to be layered. Then, too, it is difficult to know which varieties are best suited to the particular conditions under consideration.

After the trees are selected with regard to their fruiting qualifications extreme precautions must be taken to have them clean and to have the soil in which they are introduced free from insect enemies and disease. It is of vital importance that the insects and diseases attacking these fruits in China are not introduced into other countries.

Upon arrival in the new country the plants must be cared for by only those who have made special study of the natural habitat of these plants. The most careful protection against frost should be given and the highest cultural methods administered, especially in the case of the lychee. A good loam soil, extraordinary quantities of water in the soil and air, and sufficient plant food in available condition should be guaranteed to the lychee if success is to be assured.

The hardier varieties of the lungan give every promise of enduring the climate of southern Florida and California. But in the planting of any lychee trees it must be remembered that young trees are especially susceptible to frost and must be protected. This can doubtless be done in much the same way as orange and lemon trees are protected. Hsu Po (徐勃)¹, in speaking of cultural methods in Fukien, says: "The village people who love their trees burn rice straw under them and then the cold has no ill effects. In fall and winter they use wet clay and manure to protect the roots. Dead branches are cut off in order not to give trouble to the whole trunk." The Chinese recognize that excessive cold is one of the most deadly

¹ HSU P'O (徐勃), Li Chih P'u (荔枝譜) in *Ku Chin Tu Shu Chi Cheng* (古今圖書集成), *Po Wu Hui Pien* (博物彙編), *Ti'ao Muh Tien* (草木典), section 274 (第二百七十四卷), *Li Chih Pu* 2 (荔枝部二), page 4 (第四頁).

enemies of the plant and they often wrap the trunks and branches of young trees with rice straw. Ts'ai Hsiang (蔡襄)¹ reports: "The lychee tree, when first planted, dreads the cold, and until it is five or six years old it should be protected during the depths of winter from frost, snow and sleet."

The fruiting trees at the Royal Palm Nurseries at Oneco, Florida, are under cover. Mr. E. N. Reasoner, in a letter to the writer dated September 6, 1917, said: "When the severe cold wave came in February last we protected the small lychees so they had no exposure; the fruiting trees in the large shed were under cloth roof and had fire protection, but we did not *start fires* until the temperature in the shed was down to *about 28 or 29*, and in consequence the mango trees standing next row to the lychees were severely cut back. . . . The lychees were just starting a flush and the leaves were tender, but not killed at all, and no damage resulted to them in any way."

¹ TS'AI HSIANG (蔡襄), Li Chih P'u (荔枝譜) in *Ku Chin Tu Shu Chi Cheng* (古今圖書集成), *Pu Wu Hui Pien* (博物彙編), *Ts'ao Muh Tien* (草木典), section 273 (二百七十三卷), *Li Chih Pu* 1 (荔枝部一), page 4 (第四頁).

CHAPTER XVI

SUMMARY

The lychee and the lungan are two delicious and attractive fruits of South China origin. The former is so highly prized by the Chinese that it has become the subject of song and verse by Chinese poets and of lengthy treatises by Chinese writers and officials. A study of Chinese literature reveals interesting historical data with regard to the names of these fruits and their importance in the life of the Chinese people. Chinese methods of propagation and culture are therein disclosed, a knowledge of which should lead to more successful treatment in the introduction of these fruits to other lands.

European travellers to China have continuously reported the lychee and the lungan since 1585, seventy-one years after the discovery of the sea route to China in 1514. Botanists have thoroughly studied these important species and they are now attracting the attention of western horticulturists.

The whole group of sapindaceous fruits, including especially the sub-tropical lychee and lungan, and also the tropical rambutan and pulassan, deserve more adequate consideration as promising fruits for culture in the West. The lychee and lungan are the subject of this work. Sufficient botanical information regarding the relationships of these two species is at hand to warrant a series of experiments which should prove of value to the Occident in the cultivation of these fruits.

The lychee grows luxuriantly in the river deltas of the provinces of Kwangtung and Fukien. The tree is well adapted to dyke conditions and in the delta of the Pearl river, where there are hundreds of miles of dykes, the lychee industry has grown to such an extent as to warrant whole villages devoting themselves exclusively to its propagation. A lychee park has even been established near Canton. The lungan thrives under somewhat drier conditions and the industry has been developed more extensively in Fukien than in Kwangtung. The lungan will endure more cold than the lychee, but both suffer severely from heavy frosts. They attain their best development where the winters are mild and dry and the summers hot and humid.

Chinese farmers give strict attention to the cultural methods of both of these fruits. In the case of lychee they practice dyke, raised bed and upland culture. Loam soils, or those which readily hold soil moisture, are preferable. River muds are ideal for the lychee and it will endure excess quantities of moisture and floods of great duration. The Chinese are intensive feeders of these trees and practice mulching and careful frost protection.

Chinese methods of propagation of the lychee consist chiefly in "Chinese air-layering" desirable parent trees. They sometimes inarch good small-seeded varieties upon the large-seeded and more hardy stocks. Grafting the lychee and lungan is extensively practiced. The known wild relatives of the lychee and the lungan open a promising field for the determination of new and better methods of propagation and for the creation of hybrids.

The lychee is one of the most important commercial fruits in China. The history of its trade and transportation, and of the fruit formerly paid to royalty, is most interesting and instructive. The Chinese have many methods for the preservation of both of these fruits and large quantities of the dried product are exported. It is claimed that the lungan has certain medicinal qualities and large quantities of a preparation known as lungan pulp are exported from Formosa.

There are numerous insect enemies and diseases of these fruits and the introduction of more modern methods of combating them should prove of value to the Chinese. Great care must be taken not to introduce these enemies into western countries.

Chinese writers have listed scores of varieties of the lychee, but no careful elimination or classification has been attempted. A more thorough study of the *mountain* and *water* types of lychee should be made and greater effort to extend the dry culture of the fruit should be attempted.

These fruits have been successfully introduced into India and considerable work has been done with their introduction into Europe and southern United States. It is known that they will produce fruit in the West Indies and Hawaii. Special attention has recently been given to the lychee in Hawaii. A number of problems are connected with their introduction, chief among which are the difficulties of carefully selecting the best varieties for the new conditions, care in transportation and protection from salt water and cold.

No effort should be too great to bring about a successful commercial introduction of the lychee into the sub-tropical regions of the West. Search for cold resistant strains should be made in the hope of growing this fruit in Florida and California, and the very best strains of the more tropical forms should be more widely cultivated in the West Indies and in Hawaii. The fact that the lychee is a tree which responds very quickly to a peculiar type of water culture, as practiced by the Chinese living in the river deltas in South China, should lend interest to its possibilities for the low and undeveloped swamp regions of the United States.

The words of Dr. Bonavia ¹ with regard to the introduction of the lychee into India in an article which he contributed to the *Pioneer* and which has been quoted in the *Economic Products of India* by George Watt are applicable to western introduction. He said: "Here then is a fruit tree which resists the heaviest rains, and stands the hottest winds, and also the frosts of these provinces (North-West Provinces). Moreover, it bears annually an abundant crop of fine, well flavored and aromatic fruit, which can readily be sent to distant markets without injury. Instead of being planted by the one or two, it should be planted by the thousand. Of all I know of the hardiness and fruitfulness of this remarkable tree, I feel confident that if any individual (or company), possessing the necessary capital, were to plant an extensive orchard of litchi trees, say where canal water would be easily obtained, or where well water is within easy reach, he would very profitably make a life-long business of it."

¹ Bonavia, Dr., in Watt, George, *A dictionary of the economic products of India*, 1891, 6 vol., Calcutta, vol. 5, page 347.

APPENDIX I

BIBLIOGRAPHY OF CHINESE REFERENCES ON

THE LYCHEE AND THE LUNGAN

Standard Monographs on the Lychee

- 1 Ch'en T'ing (陳鼎), Li Chih P'u (荔枝譜).
Library Cong. C338.51 V. 5
- 2 Ch'en Ting Kuo (陳定國), Li Chih P'u (荔枝譜).
Library Cong. C338.51 V.97
- 3 Hsu P'o (徐勃), Li Chih P'u (荔枝譜), in Ku Chin Tu Shu Chi Cheng (古今圖書集成), Po Wu Hui Pien (博物彙編), Ts'ao Muh Tien (草木典), section 274 (二百七十四卷), Li Chih Pu 2 (荔枝部二), pages 1-5 (一至五頁).
Library Cong. 373.12 V.157
- 4 Lin Ssu Huan (木嗣環), Li Chih P'u (荔枝譜).
Library Cong. C338.5 V.6
- 5 Sung Chia (宋珏), Li Chih P'u (荔枝譜), in 'Ku Chin Tu Shu Chi Cheng (古今圖書集成), Po Wu Hui Pien (博物彙編), Ts'ao Muh Tien (草木典), section 273 (二百七十三卷), Li Chih Pu 1 (荔枝部一), pages 6-11 (六至十一頁).
Library Cong. C373.12 V.157
- 6 Tang Tao Hsieh (鄧道協), Li Chih P'u (荔枝譜), in Ku Chin Tu Shu Chi Cheng (古今圖書集成), Po Wu Hui Pien (博物彙編), Ts'ao Muh Tien (草木典), section 274 (二百七十四卷), Li Chih Pu 2 (荔枝部二), pages 5-7 (五至七頁).
Library Cong. C373.12 V.157

- 7 Ts'ai Hsiang (蔡襄), Li Chih P'u (荔枝譜), in Ku Chin Tu Shu Chi Cheng (古今圖書集成), Po Wu Hui Pien (博物彙編), Ts'ao Muh Tien (草木典), section 273 (二百七十三卷), Li Chih Pu 1 (荔枝部一), pages 2-5 (二至五頁).

Library Cong. C373.12 V.105.

- 8 Ts'ao Fan (曹蕃), Li Chih P'u (荔枝譜), in Ku Chin Tu Shu Chi Cheng (古今圖書集成), Po Wu Hui Pien (博物彙編), Ts'ao Muh Tien (草木典), section 273 (二百七十三卷), Li Chih Pu 1 (荔枝部一), pages 12-13 (十二至十三頁).

Library Cong. C373.12 V.157.

- 9 Wu Ying K'uei (吳應遠), Ling Nan Li Chih P'u (嶺南荔枝譜), in Ling Nan I Shu (嶺南遺書), book 59 (第五十九本), six sections (共六卷).

Library Cong. C338.37 V.65.

Miscellaneous Chinese Works Referring to Lychee and Lungan

- 10 Chao Tai Ts'ung Shu (昭代叢書), 1876, Chang Shan Lai (張山來), 48.

Library Cong. C338.51 V.5 & V.97.

- 11 Chih Wu Ming Shih Tu K'ao (植物名實圖攷), 1849, Wu Ch'i-Hsün (吳其濬), 17:46-95; 31:10.

Library Cong. C283.5.

- 12 Ch'in Ting Ssu K'u Ch'uan Shu Ts'ung Mu (欽定四庫全書總目), 1868, 116:36.

Library Cong. C342.20.

- 13 Ching Shih Cheng Lei Ta Kuan Pen Tso (經史證類大觀本草), 23:22-23.

Library Cong. C103.141.

- 14 Ku Chin T'u Shu Chi Cheng (古今圖書集成), Po Wu Hui Pien (博物彙編), Ts'ao Muh Tien (草木典), Chapt. 273-277.
Library Cong. C348.75.
- 15 Kuang Ch'un Fang P'u (廣群芳譜), 1708, Pei Wen Chai (佩文齋), Chapt. 60-62.
Library Cong. C283.3.
- 16 Ling Nan I Shu (嶺南遺書), 1826, Ling Nan Li Chih Pu (嶺南荔枝譜), Wu Ying Kuei (吳應遼).
Library Cong. C338.37.
- 17 Ling Wai Tai Ta (嶺外代答), 1773, Chou Ch'u Fei (周去非), 8:5.
Library Cong. C338.45.
- 18 Lung Wei Pi Shu (龍威秘書), 1794, Ma Chun Lang (馬俊良), 11:1.
Library Cong. C338.47 V.6.
- 19 Pei Wen Yun Pu (佩文韻府), 1826, 4:1.
Library Cong. C348.48.
- 20 Pen Tsao Kang Mu (本草綱目), 1596 Li Shih Cheng (李時珍), 31:4-7.
Library Cong. C103.21.
- 21 Se Fu (說郛), Chapt. 157.
Library Cong. C373.12 V.157.

Annals other than Kwangtung

Fukien

- 22 Fuhkien Tung Chih (福建通志), 1871, Wu Tang (吳棠), 59: 7-10, 31, 38, 45.
Library Cong. B192.F3.
- 23 Ch'uan Chou Fu Ma Hang Ting (泉州府馬巷廳), 1893 Wang Chia Ting (黃家鼎), 12: 5-5.
Library Cong. B192.F4 G85.

- 24 Fu Chou Fu Chih (福州府志), 1754, Hsu Ching Hsi (徐景熹), 25:11-15.

Library Cong. B192.F4.

Kwangsi

- 25 Kuangsi T'ung Chih (廣西通志), 1800, Chi Ching (吉慶), 89:6; 90:18; 91:1, 11; 92:1, 7; 93:9.

Library Cong. B192.K5.

- 26 P'ing Lo Fu Chih (平樂府志), 1877, Ching Hua (景華). 25:3.

Szechwan

- 27 Ssueh'uan T'ung Chih (四川通志), 1815, Ch'ang Ming (常明), 74:6, 9, 16, 29, 40; 75:64, 65.

Library Cong. B192.S7.

- 28 Chung Ching 'Fu Chih (重慶府志), 1843, Yu Ching (有慶), 3:48.

Library Cong. B192.S73C83.

Kweichow

- 29 Kuei Chou Fu Chih (夔州府志), 1827, Erh Cheng (恩成). 14:5.

Library Cong. B192.S73K7.

- 30 Yunnan T'ung Chih (雲南通志), 1855, Chao Shen Chen (趙慎軫), 67:23.

Library Cong. B192.Y5.

Kwangtung Annals arranged according to Prefectures and Districts

- 31 Kwangtung Tung Chih (廣東通志), edited by Yuan Yuan (阮元), 1864. Book 34 (三十四本), 59:12.

- 32 Kwangchow Fu Chih (廣州府志), edited by Shui Lin (瑞麟), 1880. Book 7 (七本) 16:10-11.

- 33 Nanhai Hsien Chih (南海縣志), edited by P'an Yao Chieh (潘若樺), 1836.

- 34 Nanhai Hsien Chih (南海縣志), edited by Cheng Meng Yu (鄭夢玉), 1872. Book 6 (六本), 8:26.
- 35 P'anyu Hsien Chih (番禺縣志), edited by Li Fu T'ai (李福泰), 1872. Book 2 (二本), 7:3.
- 36 Shunteh Hsien Chih (順德縣志), edited by T'ing Nan (廷枋), 1853. Book 2 (二本), 3:45.
- 37 Tungkwan Hsien Chih (東莞縣志), edited by Peng Jen Chieh (彭人傑), 1799. Book 7 (七本), 40:2.
- 38 Ts'ungghwa Hsien Chih (從化縣志), edited by Kuo Yu Hsi (郭遇熙), 1908. Book 2 (二本), 2:82.
- 39 Lungmen Hsien Chih (龍門縣志), edited by Yu Wen (毓雯), 1851. Book 2 (二本), 3:24.
- 40 Sinning Hsien Chih (新甯縣志), edited by Ho Fu Hai (何福海), 1892. Book 3 (三本), 8:13.
- 41 Tsengch'eng Hsien Chih (增城縣志), edited by Chao Chun (趙俊), 1810. Book 2 (二本), 1:2.
- 42 Hsiangshan Hsien Chih (香山縣志), edited by Lin Chu Huai (林祝淮), 1828.
- 43 Hsiangshan Hsien Chih (香山縣志), edited by Chen Li (陳澧), 1880. Book 2 (二本), 5:24, 25, 22:70.
- 44 Sinhwei Hsien Chih (新會縣志), edited Lin Hsing Chang (林星章), 1841. Book 2 (二本), 2:66.
- 45 Shanshui Hsien Chih (三水縣志), 1818. Book 1 (一本), 1:49.
- 46 Ts'ingyuen Hsien Chih (清遠縣志), edited by Li Wen Hsuan (李文烜), 1880. Book 1 (一本), 2:22.
- 47 Sinngan Hsien Chih (新安縣志), edited by Shu Mou Kuan (舒懋官), 1819. Book 2 (二本), 3:3.
- 48 Hwa Hsien Chih (花縣志), edited by Wang Yung Ming (王永名), 1867. Book 3 (三本), 3:39.
- 49 Chaoking Fu Chih (肇慶府志), edited by Wang Yu Shih (王瑞時), 1877. Book 3 (三本), 3:40, 41.

- 50 Kaoyao Hsien Chih (高要縣志), edited by Hsia Hsiu Shu (夏修恕), 1827. Book 2 (二本), 4:15-16.
- 51 Szechwei Hsien Chih (四會縣志), edited by Chen Chih Che (陳志詰), 1897. Book , 3:8, 80. Book 3 (三本), 1:81.
- 52 Ngenp'ing Hsien Chih (恩平縣志), edited by Yang Hsueh Yen (楊學顏), 1826. Book 5 (五本), 16:16.
- 53 Tehking Chow Chih (德慶州志), edited by Yang Wen Chun (楊文駿). Book 3 (三本), 3: 40, 41. Book , 11:7.
- 54 Shaochow Fu Chih (韶州府志), edited by Lin Shu Hsun (林述訓), 1875. Book 7 (七本), 11:38.
- 55 Kuhkiang Hsien Chih (曲江縣志), edited by Cheng Hsi Ching (張希京), 1875. Book 6 (六本), 12:20.
- 56 Hweichow Fu Chih (惠州府志), edited by Lu Ying K'uei (呂應奎), 1688.
- 57 Hweichow Fu Chih (惠州府志), edited by Liu Kuei Nien (劉湛年), 1881. Book 20 (廿本), 45:23.
- 58 Haifung Hsien Chih (海豐縣志), edited by Yu Pu Hsiung (于卜熊), 1751. Book 2 (二本), 6:53.
- 59 Ch'aochow Fu Chih (潮州府志), edited by Chang Chieh Ch'i (張介祺), 1763. Book 22 (廿二本), 39:8.
- 60 Ch'aoyang Hsien Chih (潮陽縣志), edited by T'ang Wen Tsao (唐文藻), 1820.
- 61 Ch'aoyang Hsien Chih (潮陽縣志), edited by Chou Heng Chung (周恆重), 1885. Book 5 (五本), 11:6.
- 62 Leichow Fu Chih (雷州府志), edited by Lei Hsueh Hai (雷學海), 1811. Book 2 (二本), 2:50.
- 63 Suik'i Hsien Chih (遂溪縣志), edited by Yu Ping Yung (喻炳榮), 1849. Book 5 (五本), 10:4.
- 64 K'iungchow Fu Chih (瓊州府志), edited by Lin Lung Pin (林隆斌), 1891. Book 3 (三本), 5:17.

- 65 K'ungshan Hsien Chih (瓊山縣志), edited by Li Wen Hsuan (李文烜), 1801-1803. Book 2 (二本), 3:8.
- 66 Ch'engmai Hsien Chih (澄邁縣志), edited by Hsieh Chi Shao (謝濟紹), 1909. Book 1 (一本), 2:40.
- 67 Tingngan Hsien Chih (定安縣志), edited by Wu Ying Lien (吳應廉), 1879. Book 2 (二本), 1:7.
- 68 Wench'ang Hsien Chih (文昌縣志), edited by Chang P'ei (張滯), 1719. Book 1 (一本), 2:3.
- 69 Linkao Hsien Chih (臨高縣志), edited by Nieh Ch'i Ch'ing (聶綢甦), 1893. Book 2 (二本), 4:15.
- 70 Kiehyang Hsien Chih (揭陽縣志), edited by Liu Yeh Ch'iu (劉業勤), 1780.
- 71 Kiehyang Hsien Chih (揭陽縣志), edited by Li Hsing Hui (李星輝), 1891. Book 6 (六本), 7:5.
- 72 Jaop'ing Hsien Chih (饒平縣志), edited by Liu Pien (劉曄), 1687. Book 5 (五本), 11:13.
- 73 Ch'enghai Hsien Chih (澄海縣志), edited by Li Shu Chi (李書吉), 1814. Book 7 (七本), 23:7.
- 74 Lienchow Fu Chih (廉州府志), edited by Chang Yu Ch'un (張培春), 1834. Book 3 (三本), 6:2.
- 75 Meuming Hsien Chih (茂名縣志), edited by Cheng Yeh Ch'ung (鄭業崇), 1888. Book 1 (一本), 1:77.
- 76 Tienpeh Hsien Chih (電白縣志), edited by Chang Hung (章鴻), 1827.
- 77 Tienpeh Hsien Chih (電白縣志), edited by Sun Chu (孫鑄), 1893. Book 2 (二本), 4:1.
- 78 Shihch'eng Hsien Chih (石城縣志), edited by Chang Ta K'ai (張大凱).
- 79 Shihch'eng Hsien Chih (石城縣志), edited by Chiang T'ing Kuei (蔣廷桂), 1893. Book 2 (二本), 2:41.

- 80 Loting Chow Chih (羅定州志), 1731. Book 1 (一本), 1:39.
- 81 Sining Hsien Chih (西寧縣志), edited by Chu Yu Tsung (諸豫宗) 1831. Book 2 (二本), 3:19.
- 82 Wan Chow Chih (萬州志), 1829. Book 1 (一本), 3:25.
- 83 Kinchow Chih (欽州志), edited by Chu Ch'un Nien (朱椿年), 1835. Book 2 (二本), 1:55.
- 84 Changhwa Hsien Chih (彰化縣志), 1897. Book 1 (一本), 1:18.
- 85 Yangkiang Hsien Chih (陽江縣志), edited by Li Yun (李運), 1813. Book 1 (一本), 1:7.

APPENDIX II

BIBLIOGRAPHY OF WESTERN REFERENCES

ON THE LYCHEE.

- 100 Anderson, Thomas, Asiatic Society of Bengal, Journal, 1863. vol. 32:199.
Library of Congress AS472.B3.
- 101 Aiton, William, 1731-1793, Hortus kewensis: A catalogue of plants cultivated in the Royal botanic garden, Kew. 3 vol., London, Printed for G. Nicol, 1789. vol. 2:36.
- 102 Atkinson, Edwin T., Notes on the Economic Products of the North-Western Provinces, 1881. Part V., page 57.
- 103 Baillon, Henri Ernest, 1827-1895. The natural history of plants. 8 vol., London, L. Reeve & Co., 1871-1888. vol., 5:350, 377, 394, 395, 396.
Library of Congress QK97.B15.
- 104 Baillon, Henri Ernest, 1827-1895, Dictionnaire de botanique. 4 vol., Paris, Hachette et cie, 1876-92, page 425.
Library of Congress QK7.B15.
- 105 Beddome, R.H., 1830-1911, Contributions to the botany of Southern India in the Madras Journal of Literature and Science, July, 1864, pages 39, 40.
- 106 Beddome, R. H., 1830-1911, Transactions of the Linnean Society of London. 30 Vol., London, 1791-1875. vol. 25:212.
Library of Congress QH1.L6.

- 107 Beddome, R. H., 1830-1911, *Icones plantarum indiae orientalis* or plates and descriptions of new and rare plants from southern India and Ceylon. Madras, Gantz Bros., 1874, page 21; Pl. ciii, cclxxxv, page 67.
- 108 Bentham, George, 1800-1884, *Flora hongkongensis*: a description of the flowering plants and ferns of the island of Hongkong. London, L. Reeve, 1861, page 47.
Library, U.S. Dept. of Agriculture 460B44.
- 109 Bentham, George, 1800-1884, *Genera plantarum ad exemplaria imprimis in herbariis kewensibus servata definita*. 3 vol., Londini, Reeve & Co., 1862-83. Vol. 1:405, 406.
Library of Congress QK97.B47.
- 110 Bentham, George, 1800-184, *Flora australiensis*: a description of the plants of the Australian territory. 7 vol., London, L. Reeve & Co., 1863-1878. Vol. 1:464, 465.
Library, U.S. Dept. of Agriculture 460B44F.
- 111 Birdwood, George Christopher Molesworth, M.D., *Catalogue of the Vegetable Products of the Presidency of Bombay*. Bombay, 1865. Second Edition, No. 48.
- 112 Blanco, Manuel, 1778-1845, *Flora de Filipinas segun el sistema sexual de Linneo*. Manila, C. Lopez, 1837. Vol. 2:199, 200, 201, 288.
Library of Congress QK368.B6.
- 113 Blasdale, Walter C., *A description of some Chinese vegetable food materials*. Bulletin No. 68, U.S. Dept. of Agriculture, 1899, pages 42, 43, 45.

- 114 Blume, Karl Ludwig, 1796-1862, *Bijdragen tot de flora van Nederlandsch Indie*. 2 vol., Batavia, Ter Lands drukkerij, 1825-26, page 233.
Library, U.S. Dept. of Agriculture 460B62B.
- 115 Blume, Karl Ludwig, 1796-1862, *Rumphia; sive, Commentationes botanicae imprimis de plantis Indiae Orientalis*. 4 vol., Lugduni Batavorum, prostat Amstelodami, apud C.G. Sulpke, 1835-48. vol. 3:106-111.
Library of Congress QK341.B65.
- 116 Bois, D., *Quelques arbres fruitiers Indo-Chinois*, January, 1907, page 5.
- 117 Boym, Michael, in Thevenot, Melchisedech, 1620-1692, *Relations de divers voayges*. 2 vol., Paris, A. Pralard, 1683, page 20.
Library of Congress G159.T39.
- 118 Bretschneider, Emil Vasilievich 1833-1901, *Early European Researches into the Flora of China*, 1880, Shanghai, 1881.
- 119 Bretschneider, Emil Vasilievich, 1833-1901, *History of Early European Botanical Discoveries*. 2 vol., London, S. Low, Marston & Co., 1898.
- 120 Camello, Georgio Josepho, *Herbarum aliarumque stirpium in insulo Luzone philippinarum* (Appendix to John Pay's *Historia plantarum*), 1704, pages 53 and 54.
- 121 Candolle, Augustin Pyramus de, 1778-1841, *Prodromus systematis naturalis regni vegetabilis*. 17 vol., Párisiis, Treuttel et Würtz, 1824-73, page 611.
Library of Congress QK97.C2.

- 122 Candolle, Alphonse Louis Pierre Pyramus de, 1806-1893, *Origin of Cultivated Plants*. New York, D. Appleton & Co., 1902, pages 314, 315, 316.
Library of Congress SB107. C25.
- 123 *Cyclopedia of India and of Eastern and Southern Asia*. vol. 2, page 1086.
- 124 Cook, O. F., & Collins, G. H., *Economic Plants of Porto Rico*. In *Contributions from the United States National Herbarium*, Washington, D. C., 1903. vol., 8, Pt. 2: 176, 177.
- 125 Corsa, W. P., *Nut culture in the United States, embracing native and introduced species*, 1896, page 105.
Library, U.S. Dept. of Agriculture.
- 126 Dalzell, Nicol Alexander, 1817-1878, *The Bombay flora*, 1861, Bombay, Education Society's press. Suppl. 13:13, 35.
Library, U.S. Dept. Agriculture 460D17.
- 127 Dapper, Olfert, d. 1690, *Gedenkwaardig bedryf der Nederlandsche Oost-Indische maetschappye, op de kuste en in het keizerrijk van Taising of Sina*. 1 vol., Amsterdam, J. van Meurs, 1670, pages 208, 209.
Library of Congress DS708. D22.
- 128 Desfontes, Rene, 1750-1833, *Tableau de l'Ecole de Botanique*, 1815. Paris, J. A. Brosson, 1815, page 159.
Library of Congress 2K73. P2D3.
- 129 Desfontes, Rene, 1759-1833, *Catalogus plantarum Horti regii parisiensis*. Parisus, J. S. Chaude, 1829, page 230.
Library of Congress QK73. P2D4

- 130 Dictionnaire des sciences naturelles, 1823. 60 vol.,
Strasbourg, F. G. Levrault; Paris, Le Normant.
1816-30, pages 57, 58, 59, 60.
Library of Congress. QH13. D5.
- 131 Dictionary of Popular Names of Plants, 1882, pages
248, 249
- 132 Don, George, 1798-1856, A general history of the
dichlamydous plants. 4 vol., London, J. G. & F.
Rivington, 1831-38, pages 654, 655, 670, 671:
Library of Congress QK97. D5.
- 133 Du Halde, Jean Baptiste, 1674-1743, The general
history of China. 4 vol., London, J. Watts, 1736,
pages 19, 20, 170, 171, 172, 230.
Library of Congress DS708.86.
- 134 Dunn, Stephen Troyte, 1868, Flora of Kwangtung and
Hongkong. London, Darling & Son, Ltd., 1912,
pages 66, 67.
Library, U.S. Dept. Agriculture 89K51A.
- 135 Edward's Botanical Register, 1835. 33 Vol., 1815-
1847. vol. 7; 1729.
- 136 Endlicher, Stephano, Genera Plantarum secundum
Ordines Naturales, 1836-1840. 2 vol., Vindobonae,
F. Beck, 1836-40, page 1071 - Nephelium.
- 137 Forbes, Francis Blackwell, 1839-1908, An enumeration
of all the plants known from China proper,
Formosa, Hainan, Corea, the Luchu archipelago,
and the island of Hongkong. In Journ. Linnean
Society, vol. 23, 26, 36, page 139.
- 138 Fortune, Robert, 1813-1880, Three years' wanderings
in the northern provinces of China. London, 1847,
John Murray pages 135, 384.
- 139 Gamble, J. S., A Manual of Indian Timbers. 1781
Calcutta, 1881, page 97.

- 140 Cartner, Josph, 1732-1791, *De fructibus et seminibvs plantarvm.* 2 vol., Stvtgardiae, Academiae Carolinae, 1788-91. 3 vol., Lipsiae, C. F. E. Richteri, 1801-07, pages 197, 198.
Library of Congress QK699.G113, QK699.G12.
- 141 *Gazetteer of the Bombay Presidency*, 1886. Vol. XXV, pages 52 and 150.
- 142 Georgeson, C. C., *The Economic plants of Japan.* In *the American Garden*, 1891. Vol. 12:962, 270.
- 143 Graham, John, 1805-1839, *A catalogue of the plants growing in Bombay and its vicinity.* Bombay, Govt. Press., 1839, page 29.
Library, U.S. Dept. Agriculture 460G76.
- 144 Grosier, Jean Baptiste Gabriel Alexandre, 1743-1823, *A general description of China.* 2 vol., London, G. Y. and J. Robinson, 1795, pages 425, 426, 427.
Library of Congress DS708.G87.
- 145 Gonzalez de Mondoza, Juan, *The historie of the great and mightie kingdome of China, and the situation thereof.* London, E. White, 1588, pages 14, 60, 61.
Library of Congress DS708.G644.
- 146 Hawaii, Agricultural Experiment Station, *Annual Report*, 1912, page 25.
- 147 Henry, Augustine, *A list of plants from Formosa in Transactions of the Asiatic Society of Japan.* December, 1896. Vol. 24, supplement, page 29.
- 148 Higgins, J. E., *The Litchi in Hawaii*, 1917, *Bulletin No. 44*, Hawaii Agricultural Experiment Station.
- 149 Hooker, Sir Joseph Dalton, 1817-1911, *Flora of British India.* 7 vol., London, L. Reeve & Co., 1872-97, 1:686, 687, 688, 689, 690. 460.12H76F.

-
- 150 Hosie, Sir Alexander, Report by Consul-general Hosie on the province of Ssuch-uan. 1904. London, Harrison & Sons, 1904.
Library U.S. Dept. Agriculture 127H93Re.
- 151 India Botanical Survey, Records of the Botanical Survey of India, Calcutta, 1893-1916. Vol. 1: 236, Vol. 2: 55, 92, 1893-1902, 1903.
- 152 Ito & Matsumura, Tentamen Florae Lutchuensis, in the Journal of the College of Science, Imperial University of Tokyo, Vol. 12, 1900, pages 118, 385, 386.
- 153 Ito, Tokutaro, Kinkwao Tetsuen Kwaishi (Memorial volume for the 80th anniversary of Baron Keisuke Ito). Vol. 1, M. 15, iv., Apr., 1882, Fol. 1-3 (2 col. pls.) on Lichi by K. Ito.
- 154 Jonstonus, Johannes, 1603-1675, Dendrographias: sive, Historiae naturalis de arboribus, 1662, pages 475.
- 155 Jussieu, Antoine, Laurent de, 1748-1836, Genera plantarum, Paris. 1789, pages 246, 247, 248.
Library of Congress QK93.J9.
- 156 Kew Royal Gardens, Bulletin of miscellaneous information, London, 1887, pages 219, 220.
- 157 Koorders, Frau Anna (Schumacher), Systematisches Verzeichniss der zum Herbar Koorders gehörenden, in Nederlandsch-Ostindien, besonders in den Jahren 1888-1903 gesammelten Phaneregamen. 2 vol., Batavia, 1910-1914. Vol. 1: 8, Vol. 2: v, pages 5, 34, 75.
- 158 Kurz, Sulpiz, 1834-1878, Forest flora of British Burma, 1877. 2 vol., Calcutta, Office of Supt. of Govt. printing, 1877. Vol. 1; 292, 293, 294.
Library U. S. Dept. Agriculture 460K96F.

- 159 Lamarck, Jean Baptiste Pierre Antoine de Monet de, 1744-1829, *Encyclopedie methodique. Botanique.* 8 vol., Paris, Panckoucke, 1783-1808. 2:440 1793 Supplement 3:478 1813, Tome Troisieme: 573 1789.
Library of Congress QK7.L2.
- 160 L'Ecluse, Charles, i. e. Jules Charles de, 1526-1609, *Exoticorum libri decem*, 1605, pages 36, 37.
Library of Congress QH41.L39.
- 161 Linne, Carl von, 1707-1778, *Systema naturae per regna tria naturae, secundum classes, ordines, genera, species, cum characteribus, differentiis, synonymis, locis . . .* 1767. 3 vol., Lipsiae, G. E. Beer, 1788-93. 2:18, 1277.
Library of Congress QH43.S53.
- 162 Linne, Carl von, 1707-1778, *Genera plantarum eorumque characteres naturales secundum numerum, figuram, situm et proportionem omnium fructificationis partium*, 1789, 2 vol., Francofurti ad moenum, sumtu Varrentraspian et Hennere, 1789-91. 1:262 No. 671.
Library, U. S. Dept. Agriculture 452L645G.
- 163 Linne, Carl von, 1707-1778, *Systema naturae per regna tria naturae, secundum classes, ordines, genera, species, cum characteribus, differentiis, synonymis, locis* 1796. 3 vol, Lugduni, J. B. Delamolliere, 1789-96. 2:611.
Library, U. S. Dept. Agriculture 411L64S.
- 164 Linne, Carl von, 1707-1778, *Species plantarum* 1799. Berolini, G. C. Nauk, 1797-18, 2:346 No. 755.
Library of Congress QK91.L5.
- 165 Linne, Carl von, 1707-1778, *Systema Vegetabilum*, 1825-28 5 vol., Volume II, page 222.

-
- 166 Loureiro, Juan de, 1715-1796, *Flora cochinchinensis* 1793. 2 vol., Berolini, Haude et Spencer, 1793. Pages 286, 287, 288.
Library, U. S. Dept. Agriculture 4601.93.
- 167 Macmillan, Hugh F., *Gardeners' Chronicle*, December, 1908, pages 414, 419.
- 168 Macmillan, Hugh F., *A handbook of tropical gardening and planting*, Colombo, H. U. Cave & Co. 1910, pages 167, 177, 178.
Library, U. S. Dept. Agriculture 34M22.
- 169 Martinio, Martino, 1614-1662, *Atlas Sinicus sive Magni Sinarum Imperii Geographica descriptio*. Vienna, 1655, page 123.
- 170 Matsumura & Hayata, *Enumeratio plantarum formosananarum*, in the *Journal of the College of Science*, Imperial University of Toyo, 1906. Vol. 22:95.
- 171 Matsumura, Jinzo, 1856, *Index plantarum japonicarum*, Tokioni, apud Maruzen, 1912, 2: 334, 335.
Library of Congress QK369.M3.
- 172 Merrill, Elmer D., *A dictionary of the plant names of the Philippine Islands*. Manila, Bureau of public printing, 1903. 470.
Library of Congress Q75.P5.
- 173 Merrill, Elmer D., 1876- , *The Flora of the Lamao Forest Reserve*, in the *Philippine Journal of Science*, Vol. 1, suppl. 1, April 15, 1906, pages 86, 87.
Library of Congress Q75.P51.
- 174 Merrill, Elmer D., *A flora of Manila*. Manila, Bureau, of Printing, 1912, page 305.
Library of Congress QK368.M5.
-

- 175 Miquel, Friedrich Anton Wilhelm, 1811-1871, *Flora van Nederlandsch Indie*, 3 vol., Amsterdam, C. G. van der Post. 1855-59 pages 554, 555, 556, 557.
Library of Congress QK367.M6.
- 176 Monteiro de Carvalhe, Jose, *Diccionaria portuguez das plantas, arbustos . . .* 1 vol., Lisboa, na offic. de J. F. M. de Campos, 1817, page 316.
- 177 Nooten, Mme. Berthe Hoola van, *Flours, fruits et feuillages choisis de la flore et de la pomone de l'ile de Java*. Bruxelles, E. Tarlier, 1863.
- 178 Office of Foreign Seed and Plant Introduction, Correspondence, Reports, etc.
- 179 Osbeck, Pehr, *Dagbok ofwer en Ostindisk Resa . . .* Stockholm, Lor. Ludv. Grefing, 1757.
- 180 Osbeck, Pehr, 1723-1805, . . . *Reise nach Ostindien und China . . .* Rostock, J. C. Koppe, 1765, pages 251, 265.
Library of Congress DS708.078.
- 181 Osbeck, Pehr, 1723-1805, *A voyage to China and the East Indies*, by Peter Osbeck. 2 vol., London, B. White, 1771, pages 308, 326, 327.
Library of Congress DS708.081.
- 182 Paris. Museum d'histoire naturelle. 20 vol., Paris, 1815-32. 18:30, 1829.
Library of Congress QH3P181.
- 183 Pallas, Peter Simon, 1741-1811, *Reise durch verschiedene Provinzen des Russischen Reichs in einem ausführlichen Auszuge*. 2 vol., Frankfurt und Leipzig, G. Fleischer, 1776-77, page 129.
Library of Congress DK23.P16.
- 184 Payer, J. B., *Familles Naturelles des Plantes*, 1872 Paris, G. Masson, 1872, page 316.

-
- 185 Pharmaceutical Review, 1897, pages 89, 90.
- 186 Philippine Agricultural Review, Manila, 19- , Vol. 9, No. 3, 1916, page 200.
Library of Congress S17.P4.
- 187 Pierre, Louis, i. e. Jean Baptiste Louis, 1833-1905, Flore forestiere de la Cochinchine . . . 5 vol., Paris, O. Doin, 1879-1907.
Library, U. S. Dept. Agriculture 460P61.
- 188 Plant Immigrants, Office Foreign Seed and Plant Introduction, U. S. Dept. Agriculture, Washington, July-August 1915, Nos. 111, 112. pages 907, 908 with illustrations, pages 916, 917, 918, 919.
- 189 Plukenet, Leonard, 1642-1706, *Amalthæum botanicum*, London, 1769, page 25.
Library of Congress QK41.P7.
- 190 Popenoe, F. W., in the Standard Cyclopedia of horticulture, edited by L. H. Bailey, in six volumes, New York, The Macmillan Company, 1917, Vol. 4, pages 1891, 1892, 1893 and 2131.
- 191 Quarterly journal of science, literature and art. 29 vol., London, J. Murray. 1816-30 Vol. 4, page 293.
Library of Congress Q1.Q11.
- 192 Radlkofer, L., 1829, Ueber die Sapindaceen Hollandisch-indiens, 1877, pages 25, 26, 27, 72.
- 193 Radlkofer, L., Ueber Sapindus und damit in Zusammenhang stehende Pflanzen. . . 1878. Vol. 8: pages 16, 299, 303.
- 194 Radlkofer, Ludwig, 1829, *Conspectus tribum generumque sapindacearum*, 1890, pages 16 and 17.
- 195 Radlkofer, L., Sapindaceae in Engler and Prantl. Leipzig, 1887, pages 300, 301, 328, 334.
Library of Congress QK97.F6.

- 196 Radlkofer, L., Records of the Botanic Survey of India.
Calcutta, 1907, pages 347, 348.
Library, U. S. Dept. Agriculture 460In2B.
- 197 Radlkofer, L., Die natürlichen Pflanzenfamilien . . .
Leipzig, U. Englemann, 1887, pages 204, 205.
Library of Congress QK97.E6.
- 198 Radlkofer, L., Sapindaceae philippinenses novae II
. . . May, 1913, pages 1606, 1607.
- 199 Radlkofer, L., The Philippine Journal of Science,
1913. Vol. 8:444, 445, 446, 447, 457, 458, 459.
- 200 Ray, John, 1627-1705, Historia plantarum. 3 vol.,
Londoni, H. Faithome, 1686-1704, Appendix 1:52,
53.
Library, U. S. Dept. Agriculture 452R21H.
- 201 Read, B.E., The Edible Litchi Nut (*Litchi Chinensis*)
in Journal American Chemical Society, v. 40, no. 5,
page 818 (May 1918).
- 202 Reinking, Otto A., Diseases of Economic Plants in
Southern China. The Philippine Agriculturist,
Vol. VIII, No. 4 (Nov. 1919), page 123.
- 203 Roxburgh, William, 1759-1815, Flora Indica; or
Descriptions of Indian Plants. 2 vol., Calcutta,
1832 2:279, 270, 271
- 204 Roxburgh, William, 1759-1815, Hortus Bengalensis
or a catalogue of the plants growing in the honour-
able East India Company's Botanic Gardens at
Calcutta. 1814, pages 28, 29.
- 205 Royal horticultural society, London, Transactions . . .
1812-1848. 10 vol., London, 1812-48, Vol. ,
pages 402, 405.
Library of Congress.

-
- 206 Saunders, William, Catalogue of Economic Plants in the Collection of the U. S. Department of Agriculture. No. 308.
- 207 Semmedo, Alvaro, 1585-1658, The history of that great and renowned monarchy of China. London, E. Tyler, 1655, Chapt. 1, Part, 1, pages 5 and 6.
Library of Congress DS708.S46.
- 208 Semmedo, Alvaro, 1585-1658, Relatione della grande monarchia della Dina, Romae, Hermann Scheus, 1643, page 10.
Library of Congress DS708.S49.
- 209 Shitsumo Honzo, Journal College Science, 1900. Suppl. t. 1.
- 210 Sonnerat, Pierre, 1749-1814, Voyage aux Indes Orientales et a la Chine, 2 vol., Paris, L'auteur, 1782, Part II; pages 230, 231.
Library of Congress DS506.S7.
- 211 Spach, Eduoard, Histoire naturelle des vegetaux, Paris, 1834-48, pages 61, 62, 63, 64.
- 212 Staunton, Sir George Leonard, bart, 1737-1801, An authentic account of an embassy from the King of Great Britain to the Emperor of China, 1797. 2 vol., London, G. Nicol, 1797, page 463.
Library of Congress DS708.S78.
- 213 Steudel, Ernst Gottlieb, 1783-1856, Nomenclator botanicus, enumerans ordine, 1821, Stuttgartiae et Tubingae, J. G. Cottae, 1821, pages 328, 460.
Library, U. S. Dept. Agriculture 452St4N.
- 214 Steudel, Ernst Gottlieb, 1783-1856, Nomenclator botanicus; seu, Synonymia. 2 vol., Stuttgartiae et Tubingae, J. G. Cottae, 1840-41, pages 191, 192.
Library, U. S. Dept. Agriculture 452St4N.

- 215 Taylor, W. S., Florida Grower, July 17, 1915; Florida Times Union, Feb. 8, 1916; Feb. 22, 1916; Mar. 2, 1916; Mar. 16, 1916; Mar. 23, 1916; April 18, 1916.
- 216 Therapeutique, Bulletin General, 1881, pages 325 and 326.
- 217 Thwaites, George Henry Kendrick, Enumeratio plantarum Zeylaniae: an enumeration of Ceylon plants, 1864, London, Dulau & Co., 1864.
Library, U. S. Dept. Agriculture 460T424.
- 218 Treasury of Botany, 1899, page 784.
- 219 Trigault, Nicolas, 1577-1628, De Christiano expeditione apud sinas suscepta ab societate Jesu, Libri V, 1615, Augsburg, 1615, Libri 1, page 10.
- 220 Trinidad, Botanical Department, Bulletin of Miscellaneous Information, 1888-1908, Trinidad, January, 1907, page 177.
- 221 Turczaninow, Nicolaus, d. 1864, Animadvers herb. Turez, in Bulletin de la Societe imperiale des naturalistes de Moscou, 1858. Vol 31: 402, 403.
- 222 U. S. Dept. of Agr., Division of Pomology, Bulletin No. 1, Report on the Condition of Tropical and Sub-Tropical Fruits in the United States in 1887.
- 223 Vahl, Martin, 1749-1804, Symbolae botanicae, sive plantarum, 1790. 3 vol., Hauniae, 1790-94, 2:55.
Library, U. S. Dept. Agriculture 452V18.
- 224 Vidal y Soler, Sebastian, Phanerogamae Cumingianae Philippinarum, Manila, 1885, pages 104 and 105.
Library, U. S. Dept. Agriculture 460B66P.

- 225 Vidal y Soler, Sebastian, d. 1889, Revision de plantas vasculares Filipinas, Manila, de M. Perez. 1886, pages 97, 98, 344.
Library of Congress QK368.B64.
- 226 Voigt, J. O., Catalogue of the Plants in the Serampore Garden, generally known as Dr. Carey's Garden, 1845, page 95.
- 227 Walker, Robert Sparks, in the Guide to Nature, Vol. XII, No. 3, page 34.
- 228 Walpers, Wilhelm Gerhard, 1816-1853, Repertorium botanices systematicae, 6 vol., Lipsiae, Friderici Hofmeister, 1842-48, pages 364, 365.
Library of Congress QK97.W21.
- 229 Walpers, Guilielmo Gerardo, Annales Botanices Systematicae. 7 vol., Lipsiae, F. Hofmeister 1848-68, Tomus II, page 220.
- 230 Watt, George, 1851, A dictionary of economic products of India, 1891. 6 vol., Calcutta, 1889-93. Vol. 5: 346, 347.
- 231 Wight, Robert, 1796-1872, Icones plantarum Indiae Orientalis, 1840, 6 vol., Madras, J. B. Pharaoh, 1840-53. Pl. 1; t. 43.
Library of Congress QK358.W64.
- 232 Zanoni, Giacomo, 1615-1682, Rariorum stirpium historia ex partē olim edita, Bononiae, Laelii a Vulpe, 1742, page 147.
Library, U. S. Dept. Agriculture 452. 2Z11.

APPENDIX III

Canton Weather Table*.

A TYPICAL YEAR

	Average Temp. F.	Max Temp.	Min. Temp.	Air Pressure	Humidity	Velocity of Wind	Direction of Wind
January	56.1	64.8	47.1	30.14	73	2.487	N. N. E.
February	59.7	67.5	53.6	30.06	77	1.586	N. E.
March	64.4	71.5	52.2	29.95	86	2.001	E. S. E.
April	70.4	76.2	54.9	29.87	83	1.703	E. S. E.
May	78.9	86.8	72.1	29.77	85	1.756	S. E.
June	81.7	89.1	76.1	29.62	88	2.133	S. S. E.
July	84.1	92.5	76.7	29.69	81	2.087	S. S. E.
August	82.8	92.0	75.2	29.65	82	2.135	E. S. E.
September	78.2	88.0	71.0	29.75	72	2.490	N. N. E.
October	75.4	86.5	67.5	29.98	69	2.403	N. E.
November	66.5	77.1	59.5	30.04	58	2.648	N. N. E.
December	57.7	66.8	50.7	30.12	76	3.073	N.

	Stormy Days	Dark Days	Rainy Days	Evaporation	Rainfall
January	20	7	4	69. mm.	37.7 mm.
February	10	12	6	49.2	64.3
March	6	13	12	41.9	130.6
April	13	5	12	83.1	136.4
May	12	0	19	90.2	190.9
June	3	0	22	73.9	335.6
July	16	1	14	96.5	106.7
August	15	0	16	79.1	191.1
September	23	1	6	90.7	16.7
October	28	3	0	139.4	00.0
November	25	4	1	133.1	01.9
December	17	6	8	74.3	81.7

Notes on Bad Weather:

March 12th midnight to March 13 noon heavy rain and strong wind.
 April 11th very strong winds.
 April 25th at noon a very strong wind from the N. E. followed by rain.
 May 11th to 31st there were fifteen days of rain.
 May 20. h strong wind, thunder and rain.
 June 1st to 22nd there were twenty days of rain.
 August 9th to 22nd there were eleven d ys of rain.
 August 13th and 14th strong winds and heavy rains.
 September a severe shortage of rain; more so than usual.
 October - No rain during the whole month.
 November 10th and 11th stong winds.
 Practically no rain during November.

* The above figures were taken from records of the Kwangtung Agricultural Experiment Station.

APPENDIX IV

PRESENT-DAY VARIETIES OF KWANGTUNG LYCHEE

1 亞 娘 鞋	A neung hai	Ya niang hsieh	Mother's shoe
2 掙 爆 喉	Ch'ang pau hau	Cheng pao hou	Bursts the throat
3 周 紹 玉	Chau Shiu Yuk	Chou Shao Yu	Man's name
4 狀 元 紅	Chong un hung	Chuang yuan hung	Royal red
5 苧 麻 子	Chu ma tsz	Ch'u ma tsu	China grass fiber
6 鳳 凰 球	Fung wong k'au	Fang huang ch'iu	Phoenix gem
7 妃 子 笑	Fi tsz siu	Fei tsu hsiao	Imperial concubine's laugh
8 黑 葉	Hak ip	Hei yeh	Black leaf
9 香 蓊	Heung lai	Hsiang li	Fragrant lychee
10 假 淮	Ka Wai	Chia Huai	False Wai
11 甲 由 枝	Kat tsat chi	No no chih	Cockroach lychee
12 掛 綠	Kwa luk	Kua lu	Hanging green
13 桂 味	Kwai mi	Kuei wei	Cinnamon flavor
14 落 塘 蒲	Lok t'ong p'o	Lo t'ang p'u	Rushes in the pond
15 麻雀 糰	Ma tseuk ch'un	Ma ch'iao ch'un	Sparrow egg
16 米 桂	Mai kwai	Mi kuei	Rice cinnamon
17 糯米 糰	No mai t'sz	No mi ts'z	Glutinous rice
18 糯米 團	No mai t'un	No mi tw'an	Glutinous rice ball
19 白 臘 荔枝	Pak lap lai chi	Pai la li chih	White wax lychee
20 白 芡 子	Pak lik tsz	Po le tzu	White fragrant plant
21 布 袋	Po toi	Pu tai	Cloth bag
22 犀 角 子	Sai kok tsz	Hsi chio tsu	Rhinoceros horn
23 三 月 紅	Sam ut hung	San yueh hung	Third month red
24 沙 糖 荔枝	Sha t'ong lai chi	Sha t'ang li chih	Sugar lychee
25 山 枝	Shan chi	Shan chih	Mountain lychee
26 尙 書 懷	Sheung shu wai	Shang shou huai	President of a board embraces

- | | | | | |
|----|-----|------------------|------------------|--------------------------|
| 27 | 水浮子 | Shui fau tsz | Shui fou tsu | Water float |
| 28 | 水晶球 | Shui' tsing k'au | Shui ching ch'iu | Crystal quartz ball |
| 29 | 小兒拳 | Siu i k'un | Hsiao erh ch'uan | Child's fist |
| 30 | 酸枝 | Sun chi | Suan chih | Sour lychee |
| 31 | 宋家香 | Sung ka heung | Sung chia hsiang | Sung family
fragrance |
| 32 | 大荷包 | Tai ho pau | Ta ho pao | Large purse |
| 33 | 大牛牯 | Tai ngau ku | Ta niu ku | Big bull |
| 34 | 大造 | Tai tso | Ta tsao | Large crop |
| 35 | 譚世祥 | T'am shai t'seng | T'an shih ch'ang | A person's name |
| 36 | 甜巖 | T'im ngam | T'ien yeh | Sweet cliff |
| 37 | 撻死牛 | Ting sz ngau | Ting sz niu | Hit and kill
the cow |
| 38 | 塘壘 | T'ong pok | T'ang po | Pond
embankment |
| 39 | 七月熟 | Ts'at ut shuk | Ch'i yueh shou | Seventh month
ripe |
| 40 | 將軍荔 | Tseung kwan lai | Chiang chun li | General's lychee |
| 41 | 青皮 | Ts'ing pi | Ch'ing p'i | Green skin |
| 42 | 早荔 | Tso lai | Tsao li | Early lychee |
| 43 | 貢奉荔 | Tsun fung lai | Chin feng li | Tribute lychee |
| 44 | 菜麻芝 | Ts'oi ma chi | Tsai ma chih | Vegetable hemp
plant |
| 45 | 圓臀 | Un t'un | Yuan t'un | Round rump |
| 46 | 淮枝 | Wai chi | Huai chih | Wai river lychee |
| 47 | 野山枝 | Ye shan chi | Yeh shan chih | Wild mountain
lychee |
| 48 | 玉荷包 | Yuk ho pau | Yu ho pao | Jade purse |
| 49 | 玉冰 | Yuk ping | Yu ping | Jade ice |

PRESENT-DAY VARIETIES OF KWANGTUNG LUNGAN

1	花殼	Fa hok	Hua kioh	Flower skin
2	黑核石峽	Hak hat shek hap	Hei ho shih hsia	Black seed stone gorge
3	阜圓	Ko un	Kao yuan	Fat meat ball
4	六月豹	Luk ut pau	Liu yueh pao	Six months leopard
5	什葉龍眼	Shap ip lung ngan	Shih yeh lung yen	Ten leaves lungan
6	石峽龍眼	Shek hap lung ngan	Shih hsia lung yen	Stone gorge lungan
7	蛇皮龍眼	She p'i lung ngan	She p'i lung yen	Snake skin lungan
8	頂圓龍眼	Ting un lung ngan	Ting yuan lung yen	Most round lungan
9	脆肉龍眼	Ts'iu yuk lung ngan	Ts'ui you lung yen	Crisp meat lungan
10	早禾	Tso wo	Tsao ho	Early rice
11	烏圓	U un	Wu yuan	Black ball
12	柔眼	Yau ngan	Yau yen	Soft lungan

WU YING K'UEI'S (吳應達) LIST OF VARIETIES OF LYCHEE

IN

LING NAN LI CHIH P'U (嶺南荔枝譜)¹

1	三月紅	Sam ut hung	San yueh hung	Third month-red
2	玉荷包	Yuk ho pau	Yu ho pao	Jade purse
3	犀角子	Sai kok tsz	Hsi chio tsu	Rhinoceros horn
4	白蠟子	Pak lap tsz	Pai la tsu	White wax
5	黑葉	Hak ip	Hei yeh	Black leaf
6	進奉	Tsun fung	Chin feng	Tribute
7	塘塋	T'ong pok	T'ang po	Pond
				embankment
8	凝冰子	Ying ping tsz	Ying ping tsu	Icicle
9	水浮子	Shui fau tsz	Shui fou tsu	Water float
10	尙書懷	Sheung shu wai	Shang shou huai	President of a board embraces
11	大丁香	Tai ting heung	Ta ting hsiang	Big clove
12	露頭花	Lo t'au fa	Lu t'ou hua	Showing the head flower
13	馬口鈴	Ma hau ling	Ma k'ou ling	Bell of a horse's mouth
14	香荔	Heung lai	Hsiang li	Fragrant lychee
15	掛綠	Kwa luk	Kua lu	Hanging green
16	丁香結	Ting heung kit	Ting hsiang chieh	Clove knot
17	糯米糍	No mai t'sz	No mi chih	Glutinous rice
18	火山	Fo shan	Huo shan	Fire mountain
19	田巖	Tin ngam	T'ien yen	Field cliff
20	桂味	Kwai mei	Kuei wei	Cinnamon flavor
21	苧麻子	Chu ma tsz	Ch'u ma tsu	China grass fiber

¹ WU YING K'UEI (吳應達), *Ling Nan Li Chih P'u* (嶺南荔枝譜) in *Ling Nan I Shu* (嶺南遺書), book 59 (第五十九本), section 4 (第四卷), pages 1-10 (第一頁至第十頁).

22	陳家紫	Chan ka tsz	Ch'en chia tsu	Chen family purple
23	珊瑚壁	Shan u ch'ui	Shan hu chui	Coral pendulum
24	大造	Tai tso	Ta tsao	Big crop
25	大將軍	Tai tseung kwan	Ta Chiang chun	Big general
26	小將軍	Siu tseung kwan	Hsiao Chiang chun	Small general
27	紅繡鞋	Hung sau hai	Hung hsiu hsieh	Red embroidered shoe
28	野種	Ye chung	Yeh chung	Wild species
29	七月紅	Tsat ut hung	Ch'i yueh hung	Seventh month red
30	中秋綠	Chung ts'au luk	Ch'un ch'iu lu	Chinese eighth month
31	譚世祥	T'am Shai Tseung	T'an Shih Ch'ang	A man's name
32	周紹玉	Chau Shiu Yuk	Chou Chao Yu	A man's name
33	黎仲恩	Lai Chung Sz	Li Sung Ssu	A man's name
34	有蠟	Yau lap	Yo lah	Having wax
35	蠟荔	Lap lai	Lah li	Wax lychee
36	焦核	Tsiu hat	Chiao ho	Scorched seed
37	春花	Ch'un fa	Ch'un hua	Spring flower
38	胡偶	U kit	Hu chieh	Mongols hurry
39	玉露霜	Yuk lo seung	Yu lu shuang	Jade dew frost
40	明月珠	Ming ut chu	Ming yueh chu	Bright moon pearl
41	妃子笑	Fi tsz siu	Fei tsu hsiao	Imperial concubine's laugh
42	萬里碧	Maan li pik	Wan li pi	Thousand miles greenish blue
43	麗頂珠	Li ting chu	Li ting chu	Pearl of a black horse's head
44	珊瑚樹	Shan u shue	Shan hu shu	Coral tree
45	牟尼光	Mau ni kwong	Mou ni kuang	?
46	瓊瑤彈	K'ing iu tan	Ch'ing yao tan	Beautiful bullet
47	花草春	Fa tso ch'un	Hua ts'ao ch'un	Flower grass spring
48	琥珀光	Fu p'ak kwong	Hu p'o kuang	Amber bright
49	火齊	Fo chai	Huo ch'i	Fire level

50	水晶球	Shui tsing k'au	Shui ching ch'iu	Crystal quartz ball
51	綠羅衣	Luk lo i	Lu lo i	Green netted-silk cloth
52	交几環	Kau ki wan	Chiao chi huan	Tea-poy ring
53	龍牙荔	Lung nga lai	Lung ya li	Dragon tooth- lychee
54	宋荔	Sung lai	Sung li	Sung lychee
55	孩兒拳	Hoi i k'un	Hai erh ch'uan	Baby's fist
56	綠羅袍	Luk'lo po	Lu lo p'ao	Green netted-silk robe
57	角黍	Kok shu	Chio shu	Rice dumpling
58	花嶺頭	Fa ling t'au	Hua ling t'ou	Flower ridge head
59	公領孫	Kung ling sun	Kung ling sun	Grandfather leads grandson
60	丫髻	Nga kai	Ya chi	Young maid's tuft of hair
61	鳳卵	Fung lun	Feng luan	Phoenix egg
62	白玉簪	Paak yuk ang	Pa yu ying	White jade dish
63	玉盤龍	Yuk pau lung	Yu pan lung	Jade coil dragon
64	圓珠	Lai chu	Li chu	Eye of a black horse
65	狀元紅	Chong un hung	Chuang yuan hung	Royal red
66	磨盤	Mo pun	Mo p'an	Grinding pot
67	勝畫	Shing wa	Sheng hua	Superior picture
68	將軍荔	Tseung kwan li	Chiang chun li	General lychee
69	小精丸	Siu ching un	Hsiao ho pao	Small quartz ball
70	小荷包	Shiu ho pau	Hsiao ho pao	Small purse
71	鸚鵡斑	Che ku pan	Che ku pan	Partridge strip
72	蔴紅	Sin hung	Ch'ien hung	Fresh and bright red
73	簾綠	Ts'im luk	Ch'ien lu	Bamboo slip green
74	沁肺腑	Tsam tsam fai	Ts'im fei fu	Penetrating to the lungs and bowels

APPENDIX V

ANALYSES OF LYCHEE AND LUNGAN FRUITS

by

Walter C. Blasdale ¹

	Water	Protein	Fat	Cane Sugar	Reducing Sugar	Ash	Undeter- mined
<i>Nephelium litchi (aril):</i>							
Original material	14.94	2.91	1.44	4.47	66.58	2.21	7.45
Water-free substance		3.43	1.69	5.25	77.27	2.60	8.75
<i>Nephelium longan (aril):</i>							
Original material	10.94	5.01	1.04	37.50	27.54	2.31	15.86
Water-free substance		5.63	1.17	42.11	30.70	2.59	17.80

¹ U. S. Department of Agriculture Bulletin No. 63

PRINTED BY THE COLLEGE PRESS
CANTON, CHINA



APPENDIX VI

THE LYCHEE (*LITCHI CHINENSIS*) A MYCORRHIZAL PLANT.

By FREDERICK V. COVILLE

Botanist, United States Department of Agriculture

The lychee plants brought to America by the United States Department of Agriculture and held in the greenhouse for purposes of study and propagation have seldom grown with luxuriance. Their stunted appearance and the poverty of their root development under the ordinary treatment of greenhouse plants indicated a lack of nutrition, and the idea suggested itself that the lychee might belong to that class of plants which require, or thrive best in, an acid soil.

For a preliminary experiment, twelve seedling lychee plants were procured from the Office of Foreign Seed and Plant Introduction (No. 46568). Three different soil mixtures were used, four plants being potted in each. For our present purpose only two of these soils need to be considered. One of these is the potting soil used for ordinary greenhouse purposes, made up of one part of rich loam, by bulk, one part of sand, and one part of well-rotted cow-manure. The other soil consists of two parts of upland peat and one part of clean sand.

The plants were potted in these two soils June 21, 1920, in 4-inch pots. The pots were plunged in sand, in a greenhouse in which the minimum temperature in winter is 55° Fahr. at night, 70° in the daytime. In spring, summer, and fall the temperature goes much higher.

The difference in behavior of the lychee in the two soils is conspicuous, as is shown by typical plants from the two lots, seven months after potting, reproduced in Plate XX. The growth of the plants in the ordinary potting soil is very feeble; in the acid soil it is free and luxuriant.

Corresponding inequalities of growth have taken place underground. In the ordinary soil the root development is feeble and is confined chiefly to stout, unbranched leaders which have pushed through to the bottom of the pot. In the acid soil the plants have produced similar root leaders, but more freely, and in addition there is an extensive development of smaller much-branched roots. These lie chiefly at the sides of the root-ball, against the wall of the pot. Some of the plants in the ordinary soil have developed similar branched roots, but much less extensively.

The characteristic of greatest interest, however, in the acid-soil plants is that their branched roots are covered with tubercles, and that these tubercles are gorged with mycorrhizal fungi. The appearance and the abundance of these tubercles are well shown in Plate XXI.

Dr. Emil G. Arzberger, of the Office of Crop Technology, with exquisite technique, has fixed, stained, and sectioned the tubercles, and has made drawings and photographs. His descriptions and illustrations leave no question that these tubercles are genuine symbiotic mycorrhizas. Three photographs and four drawings by Dr. Arzberger, showing the mycorrhizal fungi in the cells of the tubercles, at enlargements of 195 to 830 diameters, are reproduced in Plates XXII and XXIII. None of the plants in the ordinary soil developed these tubercles.

This experiment was conducted without knowledge that Professor Groff was writing a book on the lychee. Ordinarily such an experiment would be repeated many times for verification before the results were published, but it has seemed desirable to publish this brief statement at once, since the experiment points to conclusions of fundamental significance in the life history of the lychee and suggests a definite and unusual line of agricultural practice, at the very beginning of the culture of the lychee in the United States.

The experiment indicates that the mycorrhizal fungus is beneficial to the lychee plant, probably, indeed, essential to its vigorous growth and productivity; that an acid soil is necessary for the maintenance of the fungus; and that a soil of peaty type is the most promising for lychee culture. Repeated experiments should be made to test the validity of these indications. Dr. Arzberger is making a detailed study of the lychee root fungus for more extended publication.

Although these mycorrhizal tubercles presumably occur on the roots of the lychee in China, they have never been recorded or observed there, so far as Professor Groff is aware. A reëxamination of lychee culture in China, in the light of the present experiment, will be of great interest, for it is likely to be found that this industry is a genuine acid-soil culture, developed as such by the Chinese, unconsciously and empirically, from the ancient and cumulative experience of that amazing people.

APPENDIX VII

LACK OF WINTER DORMANCY AND THE LOW ZERO POINT OF GROWTH OF THE LYCHEE LIMITING FACTORS IN ITS CULTURE IN FLORIDA.

By WALTER T. SWINGLE
United States Department of Agriculture

Canton, China, is in the same latitude as Havana, Cuba. Coconut palms abound in Cuba and also in southern Florida, but the visitor to Canton looks in vain for them. The coconut palms grow in numbers on the shores of Lake Worth, Florida, in latitude $26^{\circ} 45'$, just three and one-half degrees north of Havana.

The lychee has not as yet been grown successfully without protection in any part of Florida; and yet it is grown commercially in the southern part of Fukien Province, especially about Hsinghwa Fu (now P'ut'ien Hsien), two degrees north of Canton. I passed through Canton late in January, 1919, and found the weather cloudy and distinctly chilly. I was told that there had been practically no sunshine for a month. To my surprise, the lychee trees growing on the dykes on the Canton Christian College grounds on Honan Island showed a beautiful wine-colored flush of new growth. The daily meteorological records of the Freeman Meteorological Observatory at the Canton Christian College for January, 1919, give the following record of temperature and humidity:

Day	Temp. at 7 A.M. Deg. Cent.	Max. Temp. Deg. Cent.	Min. Temp. Deg. Cent.	Humidity 7 A.M. per cent.	Avg. Humidity 7 A.M., 1 P.M. 6 P.M., per cent.
1	13.0	17.8	10.8	95	86
2	9.4	12.8	9.0	70	61
3	4.1	13.4	4.0	61	52
4	5.6	15.6	3.8	72	56
5	7.6	19.1	5.2	71	52
6	9.5	20.9	7.3	87	61
7	13.7	23.5	9.0	81	73
8	17.5	23.4	13.4	92	91
9	19.4	25.5	17.0	97	89
10	19.0	27.9	18.4	96	83
11	19.8	26.4	17.0	98	86
12	14.1	20.0	13.9	83	75
13	14.2	19.9	13.7	77	93

Day	Temp. at 7 A. M. Deg. Cent.	Max. Temp. Deg. Cent.	Min. Temp. Deg. Cent.	Humidity 7 A.M. per cent.	Avg. Humidity 7 A.M., 1 P.M. 6 P.M., per cent.
14	15.4	20.7	13.9	88	86
15	17.7	20.5	17.3	93	86
16	13.2	19.1	12.3	81	80
17	15.7	22.5	12.8	89	85
18	17.6	23.4	16.8	92	85
19	10.2	13.8	10.1	77	77
20	9.1	12.6	8.9	66	70
21	8.9	12.7	8.6	76	82
22	7.4	12.1	6.8	89	87
23	10.2	17.5	9.6	94	93
24	16.1	23.3	15.2	98	97
25	..	12.8	11.8	95	93
26	..	12.5	9.3	98	93
27	..	12.1	8.9	98	93
28	..	12.4	8.8	89	87
29	..	18.5	8.0	97	96
30	14.0	15.0	7.9	89	94
31	9.5	10.5	9.3	92	94
	12.8	18.0	10.9	86	82

The mean temperature for the month, obtained by taking the mean between the maximum and minimum, is 14.45 Cent. or 58.01 Fahr.

Unfortunately, there is no sunshine record for January, 1919. The record for February, 1920, which tabulates similar but slightly lower maximum temperatures, shows only the following hours of sunshine for the month:

Day of Month	Hours and Minutes of Sunshine
1	0 h. 33 min.
6	0 h. 4 min.
15	0 h. 19 min.
17	2 h. 20 min.
29	1 h. 52 min.

Total, 5 days 5 hrs. 8 min.

Only five hours and eight minutes of sunshine for a month! And the last five days of January, 1920, had also been without sunshine.

The raw winter climate of Hongkong, in the latitude of Cienfuegos, Cuba, is well known. Many other tropical plants besides the coconut fail to thrive there. In spite of the coldness of the winter climate, frost is practically unknown there and is very rare in Canton, and never severe.

A comparison of the records for January, 1919, for Canton,

China, and the average for six points in Florida* for a long period of years is shown below:

Station (Location)	Latitude (North)	Mean Temp. °Fahr.	Mean Max. °Fahr.	Mean Min. °Fahr.	Hours of Sunshine
Canton, China. (Jan. 1919)	23° 06'	58.01	64.4	51.6	5 hr. 8 min. (Feb. 1920)
Key West, Fla.	24° 34'	70.00	74.00	65.00	
Miami, Fla.	25° 46'	65.00	74.00	57.00	
Ft. Myers, Fla.	26° 38'	62.00	72.00	52.00	
Tampa, Fla.	27° 57'	59.00	68.00	50.00	194 hours
Eustis, Fla.	28° 50'	58.00	69.00	48.00	
Jacksonville, Fla.	30° 20'	55.00	64.00	46.00	161 hours

It is evident at a glance that the Canton climate in January, 1919, was much colder than the average of south Florida points, and especially the mean maximum temperature was much lower. The thermometric records do not fully show the difference between South China and Florida, since the bright sunshine (50 to 60 per cent or more of the total possible) of the south Florida winter would heat the leaves, buds, and twigs of a tree to a higher temperature than that of the air, while nothing of the kind happens during cloudy weather in China.

The records reprinted above show that at Canton, China, during the eleven days from January 8 to 18, 1919, the minimum temperatures were above 12.3° Cent. (55.1° Fahr.), the daily mean temperatures were above 15.7° Cent. (61.3° Fahr.), and the maximum temperatures were above 19.1° Cent. (66.4° Fahr.), the hottest day being the 10th with the minimum 18.4° Cent. (66.1° Fahr.), the mean 23.2° Cent. (73.7° Fahr.), and the maximum 27.9° Cent. (82.3° Fahr.). Probably the growth on the lychee trees observed about January 25 resulted from this spell of warm weather.

Such a moderate warm spell as this is sure to occur during every Florida winter, with the added stimulus of bright sunshine half or more of the time.

If a surmise be ventured, I would place the zero point of growth of the lychee, in the light of the facts recorded above, between 16° Cent. and 18° Cent. (about 60°-65° Fahr.). It is clear that the lychee has a very low degree of winter dormancy.

The fact that the lychee was growing at Canton in the last week of January, 1919, in spite of prolonged cloudy weather and low maximum and mean temperatures, proves that it is able to

*Henry, Alfred J. *Climatology of the United States*. Weather Bulletin B., Washington D. C., 1906, pp. 352-361.

break out into new growth at relatively low temperatures; in other words, that it has a low zero point for vegetative growth, just as the West Indian lime, *Citrus aurantifolia* (Christm.) Swing., and the guava, *Psidium Guajava* L., both of which are forced into a tender new growth by a few days of warm weather such as commonly occur during a Florida winter. Both of these plants suffer severely from cold in all but extreme south Florida.

It appears very probable, then, that the lychee has heretofore failed to grow in Florida without protection not so much because of any extreme sensitiveness to cold as because of its lack of winter dormancy and low zero point of growth which cause it to put out tender new growth very liable to be injured by even moderate cold snaps. Experience in Florida has shown only too clearly that once the lychee has started into a tender new growth it is severely injured even by very slight frost that would have no effect whatever on mature leaves and twigs.

It would appear desirable to test the lychee in south Florida by giving it the protection of a lath shed. Possibly the trees should be shaded on hot days to prevent the breaking out of new growth; certainly they should be protected by fire-pots, if necessary, on cold nights, and during cold winds if in growth.

After the lychee has been grown successfully with such protection it might be possible to work out methods of culture in certain favored locations without the expense of sheds, giving only protection by fires during severe cold spells.

The lychee is able to stand prolonged hot, moist weather in summer, in fact probably requires such weather in order to grow vigorously and fruit abundantly. The summer climate of south Florida is very much like that of south China, and doubtless the lychee will feel at home in Florida if it can be properly protected during the winter.

In view of the exquisite flavor and superb beauty of the ripe fruit of the choicest varieties of the lychee, there is every reason to expect that this, the most highly esteemed fruit of China, will be grown in special greenhouses by amateurs all over the United States. Our hot summers, so trying to many flowers and fruits of Europe, would be beneficial rather than injurious to the lychee, and as a relatively low temperature during winter is advantageous to this tree, the expense of maintaining such a lychee house would be less than that of an ordinary greenhouse. Now that Professor Groff has brought the finest varieties of the lychee to the United States and Dr. Coville has worked out the soil requirements of this plant, there should be no serious difficulty encountered in fruiting this tree under glass.

APPENDIX VIII

ROOTING LYCHEE CUTTINGS BY MEANS OF A HIGH TEMPERATURE AND HIGH HUMIDITY PROCESS.

By EDWARD GOUCHER

United States Department of Agriculture

The vegetative propagation of certain woody plants, especially some of the tropical and subtropical fruits, including the lychee, has always involved problems more or less difficult of solution. In the past, various methods to root both hard and soft wood cuttings have been tried with varied success, but not any have proved entirely satisfactory or reliable.

In the case of the lychee there has been special need for improved methods of propagation. Heretofore it has been necessary to propagate the desired varieties either by the inarch method or by grafting on seedling stocks. As these stocks must all be grown from short-lived seeds, secured abroad, which are very difficult to obtain in living condition, an attempt to establish in the United States an industry in this valuable fruit has been greatly retarded.

With the object in view, therefore, of finding a solution of the difficulties, several experiments with cuttings of lychee were made as follows:

(1) Cuttings were taken from the tips of young shoots. These were made from four to six inches long and the foliage was reduced about one-half. A ball of sphagnum moss was tied about the base of each cutting and these were then placed in pans in a warm propagating-case.

(2) Another lot of cuttings was placed in a mixture of Jersey muck and silver sand, in a case similar to the above.

Not any of the cuttings in either of these two experiments rooted, but their behavior was very valuable in later experiments. In the hot, humid atmosphere of the propagating-case all of the cuttings of lychee, placed in both the moss and soil, had their lower ends decayed, while the tops remained in splendid condition. And some cuttings formed a callus just above the surface soil, indicating that they needed more aëration at their base.

(3) The third trial was then made with cuttings set in inverted pots, the stem ends shoved through the holes in the bottom. A small quantity of sphagnum moss was packed about the base so as to steady them, and the inverted pots were then placed on a bed of moss in the propagating-case. About forty per cent of

this lot formed roots, the remainder decaying at the base, but with some callousing above the dead wood.

(4) In the final and most successful experiment a number of three-inch pots were two-thirds filled with a mixture of Jersey muck and silver sand of equal parts. The cuttings were made with only a small portion of the foliage removed. Each cutting was then tied to a six-inch pot label, and the labels were shoved down into the partly filled pots until the base of each cutting just touched the soil. These cuttings formed a callus in from eight to ten days and some sent their roots down into the soil in twenty days after planting. Eighty per cent of these cuttings rooted, and when they were thoroughly rooted the pots were filled with soil and the plants were removed to a cooler section of the propagating-case in order to prepare them gradually for greenhouse conditions.

Construction of the Propagating-Case.

The propagating-case contains a shallow, galvanized iron pan for water which is heated by means of an electric heater or a small oil-stove hot-water equipment. Over the pan is placed a false bottom of one-fourth-inch wire mesh which is covered with moss. Upon this moss the pots containing the cuttings are placed. Over the box, which is tightly constructed so as to conserve all the heat, a hinged sash is fitted. This must fit sufficiently snug to prevent evaporation.

A very simple outfit for field use has been made similar to the above. The heating equipment consists of an oil-stove with water attachment. A small one gallon boiler is located immediately over the oil-stove, not unlike an incubator. A one-inch pipe extends out from the top of the boiler, and under the water-tank which it encircles, and then returns to the bottom of the boiler.

Preparation and Treatment of Cuttings.

As already indicated, great care must be taken in the preparation of cuttings not to allow them to become dry. After they are removed from the parent plant they should be immediately immersed in water. The lychee seems to delight in a hot, moist atmosphere. A temperature of 85 to 90 degrees should be maintained in the propagating-case and cuttings should be kept moist at all times. The foliage should be wet down several times during the day if necessary, and shaded from bright sunlight. The lychee is peculiar in its ability to stand up under these hot, moist conditions. Cuttings of other fruits will collapse completely; others

callous but do not send out roots; and still others go to pieces in a few days. The lychee, on the other hand, will quickly wither if allowed to become dry.

The chief difficulties experienced have been in removing the plants from the sweat-box. This must be accomplished gradually, and in order to do this one should have one or two other boxes in which there is a gradual let-down of temperature and humidity. With the right kind of cuttings and facilities there is no reason why the propagation of the lychee from cuttings should not prove a most advantageous commercial method of multiplying desirable varieties of this interesting plant.

APPENDIX IX

SUNG CHIO'S ACCOUNT OF THE ORGANIZATION OF A LYCHEE CLUB AT P'UT'EN, FUKIEN PROVINCE, DURING THE MING- DYNASTY*

Translated by Michael J. Hagerty, Chinese Translator of the United
States Department of Agriculture, assisted by Ch'ên
Ts'ing-hua and Wu Mien

INTRODUCTION

Sung Chio (literary name Sung Ta-mo) in 1608 wrote his *Li chih p'u* or treatise on the lychee. He was a native of P'ut'ien district in Hsinghwa prefecture, one of the famous lychee-growing regions in Fukien Province.

His treatise is reprinted both in the Imperial Encyclopedia (see p. 119, No. 5) and in Mr. Wu's great work on Chinese Botany (see p. 120, No. 11). It contains seven chapters, as follows: 1. "Fortunate Occupation" (Introduction); 2. "The Lychee Club"; 3. "The Narrative" (History); 4. "Records of the Sung Family Lychee"; 5. "Lychee Wine"; 6. "Remarkable Events"; 7. "The Lychee Slave (Lungan)." The whole treatise is written in a highly imaginative style and is replete with hyperboles and literary allusions. The author extols the lychee above all other fruits. "The lychee is the genius, the Buddha of the fruits; there is nothing to be compared to it," so he begins his treatise. In the first chapter he tells of eating a thousand or two lychee fruits a day and a hundred thousand fruits during the season. Only two of his friends, Kuo Shêng-tai and Fang Tzu-tao, could eat as many. He says, "I took pleasure in separating the varieties and enjoyed compiling this treatise."

Under the heading "Unalloyed Bliss in Eating the Lychee," he lists thirty-three favorable or auspicious circumstances which add to the pleasure of eating lychee, such as: "the coming of agreeable friends," "facing flowing water," "examining treatises on the lychee," etc., etc. Then under "Somber Happenings in Eating the Lychee," he lists thirty-four unfavorable circumstances tending to diminish the pleasure derived from eating the lychees, such as: "heavy rains," "having people about who do not like to eat lychees," "listening to bad poems or songs," "urging guests not to eat lychee under pretense of avoiding ill effects from the heat," appearance of the Pine cone variety," (the last to ripen, marking the end of the season), etc., etc.

*This translation of Sung Chio's account of a lychee club is taken from the second chapter of his *Li chih p'u* reprinted in the Chinese Imperial Encyclopedia, Book 273, Hui Kao, Pt. 1, fol. 7 of the Small Edition, or Pt. 1, fol. 15-16 of the Imperial Edition.

Sung Chio's entire work and the five other treatises on the lychee reprinted in this Encyclopedia, have been translated by Mr. Hagerty assisted by Ch'ên Ts'ing-hua and Wu Mien. Photostat copies of the typewritten translations, as well as of the entire text of the Imperial Edition of the Encyclopedia referring to the lychee and lungan (Books 273-277 and part of Book 280, in all, 202 folios), may be secured by arrangement with the Library of the U. S. Department of Agriculture, Washington, D. C. Translations of the other four treatises on the lychee (Nos. 1, 2, 4 and 6, on pp. 118-119), not reprinted in the Imperial Encyclopedia, as well as the Chinese texts, can also be secured there.

The Library of the U. S. Department of Agriculture has also a set of photostat copies of the historical and botanical references on the lychee from western sources, 409 pages in all, prepared by Mrs. Walter T. Swingle (Nos. 100-232, see pp. 127-141). These also may be secured by special arrangement.

CHAPTER II

The Lychee Club

"The people of the Min-hao¹ region (though living near the lychee districts) do not all see the lychee. To see this fruit, to obtain some to eat during the ripening season, and when eating to obtain one's fill, to taste all the famous varieties—these, like visiting the Mermaids' palace² and Ch'i Nu's³ mansion to obtain all one wants of bright pearls an inch through and coral branches ten feet long, are not easy. The people of leisure in Wu⁴ and Yüeh⁵ (far distant from the lychee districts) who hear of this fruit can enjoy it only through their ears, though the hearing of it makes them imagine they can see it and causes their mouths to water so profusely that they wet their feet and are compelled to roll up the skirts of their robes, embarrassing them so that they do not know what to do. There has been no lack of curious people in the world who nevertheless do not travel a thousand or a hundred *li* to see this fruit. The natives (living in lychee districts) are so accustomed to seeing and hearing of this fruit that they do not appreciate those bright pearls and corals and even regard them as being no better than sweet peaches or sweet plums. So therefore I have written the metaphors on "Unalloyed Bliss" and "Somber Happenings" (see above).⁶

"My friends of the same tastes as myself in the village are few and their capacity for eating lychee is very small.⁷ Many times I have wanted to invite a number of friends to form a club like the Lien She⁸ and the Mei She,⁹ but for one reason or another this wish was never realized. At the end of spring Fang Tzu-tao came to see me and I talked to him about this subject. He was pleased and said: 'Last summer while visiting in Yün-chien¹⁰ I earnestly thought about this fruit and now I shall not lightly reject this opportunity.' Accordingly, on the 6th day of the 6th month we began to meet in the Ts'ui family garden now belonging to the

¹ Fuchow in Fukien Province.

² The *Siku I Chi* (collection of notes on the wonderful, by Jên Fang of the early part of the 6th century) says that the Chiao Jên or Mermaids dwell under the water like fish, where they weave without stopping and when their tears drop from their eyes they turn into pearls. See T'z'u Yuan p. 56, under the 105th radical.

³ This is the 'hao' or pseudonym of Shih Ch'ung, a man famous for his great wealth, which he was fond of displaying. See Giles C. P. D., p. 651.

⁴ Kiangsu Province.

⁵ Chekiang Province.

⁶ This introductory paragraph is so obscure and so full of hyperboles as to be difficult to render literally in English.

⁷ As compared with his own capacity to eat one or two thousand fruits a day.

⁸ Lien She—Lotus Club.

⁹ Mei She—Plum Blossom Club.

¹⁰ The present Huat'ing district in Sunkiang prefecture in Kiangsu.

brothers Lin Ch'ien-po and Lin Shou-po and we agreed to meet once every day until the lychee fruiting season was over and then stop. The by-laws of our club consisted of five articles. I was made director of the club. Though this fruit is a wonderful and mysterious thing, yet we are able to value, cherish, and also guard it by forming into a club those who have the same liking for it as ourselves.

"We will meet when the weather is fine. For a tent we will use the heavy shade. For a bath we will use the cold fountain. For a covering we will use clothing that the breezes blow through. For illumination we use cool moonlight. To mix with the lychee we will use dark blue wine. For relief (from over-eating) we will drink cold syrup. To verify statements concerning the lychee we will use the old records. To record our business we will use new poems.

"Although we are living in a foul, dusty world, still we are able to view the borders of the capital of the genii and while our bodies dwell within a fiery city, our spirits roam throughout the cool valleys. Not only those people of leisure living in Wu and Yüeh cannot gratify these longings, even Po Fu¹ who broke the purple silk in Nan-pin² or Su Wêng who was presented with some deep red hornless dragon pearls (ch'ên ch'iu chu)³ in Ling-piao⁴ are like one who calls himself venerable when there is no Buddha around and that they could not compete with us is clear.

By-Laws:

(1) "The club begins to meet when the *Huo shan* (Volcano) variety is entirely ripe and ceases to meet on the day when the *Sung lei* (Pine cone) variety comes forth. Each day one member acts as director and procures three thousand fruits as an average, but if there are more, then the pleasure is greater.

(2) "Whoever acts as director sends out announcements before the time of meeting. As the club has no fixed meeting-place, either an old Buddhist temple or a famous garden will be

¹ Po Chü-i.

² This is an allusion to the following incident noted in the biography of Po Chü-i found in Old History of the T'ang dynasty: "The lychee fruit grown around the gorges of Pa I or Eastern Sauch'uan has a hull that is like red silk, and inner skin that is like purple silk. Its pulp is bright like frozen snow with juice of a 'sweet sour' taste like rich, sweet wine." See *P'ei Wen Yün Fu*, Bk. 17, p. 58, r.

³ Ch'ên Ch'iu chu—deep red, hornless dragon pearls. This is an allusion to an incident mentioned in the following two lines of a poem written by Su Tung-p'ô upon eating some lychee fruit on the 11th day of the 4th month:

"You rinse the wine cups and pour out the excellent wine,
While on this transparent dish you present me with these
deep-red hornless dragon pearls."

⁴ Ling-nan. See *P'ei Wen Yün Fu*, Bk. 7, Pt. 1, p. 108, r.

suitable for this purpose. One may come by boat or horseback, following the course he finds suitable. The club will often meet in remote country places where we will have even more seclusion.

(3) "The club will meet in the morning and adjourn in the evening. At noon we will eat some vegetable congee and in the evening supplement this with several cups of clear broth. There will be no large vessels of strong rank meats to mar the refinement of our gatherings.

(4) "When about to separate each member must select a theme and a rhyme and at the following meeting he must present his poem. If it is not finished he is punished by having three thousand fruits taken from him. At meeting-time, members will devote themselves to eating and drinking and not occupy themselves with poems and songs but each following his own inclination may either take the tripod for warming tea, play chess, recline upon a pillow or mat, enjoy fragrant incense, chat, laugh and not bother about anything else.

(5) "Those who disturb our ideas and who shirk should be dealt with strictly, while the dilettanti who enter (uninvited) shall not be excluded."

APPENDIX X

DETAILED DESCRIPTION OF ILLUSTRATIONS

PLATE I. Reproduction of a painting of the lychee attributed to the Sung Emperor, Hui Tsung (1100-1126 A. D.) and entitled "The Ch'en Purple Lychee Embroidered Fragrant Bag." Photograph, February, 1921, by permission of The Metropolitan Museum of Art (one-third natural size).

PLATE II, *Frontispiece*. A Kwangtung lychee landscape. A nine-story pagoda, a Canton slipper-boat and lychee trees along the dykes of the streams. Honan Island, Canton, China. January, 1915. Photograph (No. 1049.544) by the author.

PLATE III, FIGURE 1a. Reproduction of a rubbing of the "Li Chih P'u" by Ts'ai Hsiang (two-fifths natural size). This work was composed in Fukien Province, China, in 1059 A. D. It was divided into seven parts of which this page, scarred and cracked, represents the first portion of Part I. The work is possibly the oldest horticultural monograph extant. Ts'ai Hsiang's literary name is (Ts'ai) Chun-mo; and his canonization title, given by the Emperor after his death, is (Ts'ai) Chung-hsiang Kung. Photograph, December, 1920, for the author, from the copy in the Library of Congress Chinese collection.

The set of rubbings from the inscription on stone, in the Library of Congress Chinese collection, is mounted, Chinese style, in a folded portfolio of 70 pages. Photostat copies of this, as well as of a set of rubbings from a facsimile copy on wood, in which all the characters are perfect, can be secured by arrangement with the Library of the United States Department of Agriculture.

PLATE III, FIGURE 1b. Reproduction of a copy of the "Li Chih P'u" by Ts'ai Hsiang, neatly written upon silk. This page also represents Part I of the work and is reproduced here about two-fifths natural size. The silk copy which has been in the possession of one Chinese family for at least five generations, though slightly worm-eaten, is well preserved. Photograph, 1920, for the author.

PLATE IV, FIGURE 1c. Reproduction of a reprint of the "Li Chih P'u" by Ts'ai Hsiang, representing the first page of Part II as it appears in the Tsung Li Yaman reprint of The Chinese Imperial Encyclopedia (two-thirds natural size). Photograph, 1920, for the author, from the copy in the Library of Congress Chinese collection.

PLATE V, FIGURE 2. Fruiting material of an herbarium specimen of *Litchi philippinensis* Radlk (one-half natural size). The specimen was collected in Tambalos Province, Luzon, P. I., in April, 1905, by W. M. Maule. A quotation from Radlkofer, attached to the specimen, states: "These fruits seem really partly to split by exsiccation, but nevertheless the plant is from floral and anatomical characters a true litchi." It is important as a matter of record to note, on the leaves of this specimen, lychee leaf-galls, a species of *Eriophyes*, a conspicuous enemy of the cultivated lychee (see page 84). Photograph by the author (No. 31136), February, 1918, with permission of the Bureau of Science, Manila, P. I.

PLATE V, FIGURE 3. Fruiting material of an herbarium specimen of *Euphoria cinerea* Radlk (one-half natural size). The collector was H. N. Whitford. The fruits were secured from a 50-meter tree growing at the foot of a hill, on river-bottom land, along Lamao River, P. I. Photograph by the author (No. 31134), February, 1918, with permission of the Bureau of Science, Manila, P. I.

- PLATE VI, FIGURE 4. The root system of a mature lychee tree, as seen along the side of a dyke, the earth of which had been washed away by flood. Near Nan Kang, Kwangtung, China, March, 1917. Photograph (No. 1151) by the author.
- PLATE VI, FIGURE 5. A flower panicle of the lychee, San yueh hung variety. Near Nan Kang, Kwangtung, China, March, 1917. Photograph (No. 1152) by the author.
- PLATE VII, FIGURE 6. An inner and an outer dyke along the Pearl River, both planted with lychee trees. In the low, wet field, bounded by these dykes, Cantonese farmers are setting out, in straight rows, young rice plants. Ling Nan (Canton Christian College), Canton, China, April, 1915. Photograph (No. 1057.595) by the author.
- PLATE VII, FIGURE 7. A lotus pond surrounded by dykes. The limb of a lychee tree extends out over the pond. Li Chih Wan (Canton's Public Fruit Park), Canton, China, June, 1915. Photograph (No. 1069.702) by the author.
- PLATE VIII, FIGURE 8. A dyked field in the Canton Delta, planted to sagittaria. Cantonese women are standing in the mud, up to the knees, harvesting the crop. Notice again lychee trees planted along the dykes. Near Canton, China, December, 1913. Photograph (No. 1029.281) by the author.
- PLATE VIII, FIGURE 9. Fish-ponds, in which fish are cultured, formed by the dykes constructed along the Pearl River. Students standing under the lychee trees and fishing in the ponds. Ling Nan (Canton Christian College), Canton, China. Summer, 1916. Photograph (No. 4120.1339) by the author.
- PLATE IX, FIGURE 10. Pearl River dykes held in place by stone walls and lychee trees. Ling Nan (Canton Christian College), Canton, China. June, 1914. Photograph (No. 1038.443) by the author.
- PLATE IX, FIGURE 11. The Pearl River in flood, showing the ability of the lychee to withstand the submersion of roots for long periods of time. Floods in Kwangtung are frequent and severe, but lychee trees, planted along the dykes, withstand the force of the streams. Ling Nan (Canton Christian College), Canton, China. July, 1915. Photograph (No. 1078.753) by the author.
- PLATE X, FIGURE 12. A walk along a lychee dyke. Near Canton, China, March, 1917. Photograph (No. 1153) by the author.
- PLATE X, FIGURE 13. The dykes in south China are usually planted to fruit. Lychee trees on the left and plum trees on the right. Honan Island, Canton, China, January, 1915. Photograph (No. 1050.545) by the author.
- PLATE XI, FIGURE 14. Students picking lychee in the well-formed dyke plantation of the Canton Christian College. These trees are the Huai chih variety. The students often purchase a whole tree of fruits. This photo was taken when the tides were high and the water reached to the branches of the trees. Ling Nan, Canton, China, July, 1914. Photograph (No. 4052.454) by the author.
- PLATE XI, FIGURE 15. Crop watcher who, during the fruiting season of lychee, sleeps and eats on the dykes, thus protecting his crop. Note his thatched hut on the right, under the trees. He has picked a basket of fruits and is preparing them for the market. Ling Nan, Canton, China, June, 1915. Photograph (No. 1063.695) by the author.

PLATE XII, FIGURE 16. Ling Nan lychee ready for the market. This is one of the types of basket, made locally from stripped bamboo, in which the fruit is marketed. Ling Nan (Canton Christian College), Canton, China, July, 1914. Photograph (No. 4053-455) by the author.

PLATE XII, FIGURE 17. Clusters of lychee, Huai chih variety, as they form on the trees. Ling Nan (Canton Christian College), Canton, China, June, 1915. Photograph (No. 4070-694) by the author.

PLATE XIII, FIGURE 18. A group of Canton Christian College Middle School students as seen at the time of a favorite practicum—a study of the varieties of the lychee. Ling Nan, Canton, China, June, 1915. Photograph (No. 4069-693) by the author.

PLATE XIV, FIGURE 19. A fruiting limb of a lychee tree. Ling Nan (Canton Christian College), Canton, China, June, 1915. Photograph (No. 1156) by the author.

PLATE XIV, FIGURE 20. The head of a lychee tree in fruit, showing the extremely heavy yield. Note especially how the heavily fruiting limbs have been braced with bamboo poles. Ling Nan (Canton Christian College), Canton, China, June, 1915. Photograph (No. 1157) by the author.

PLATE XV, FIGURE 21. Lychee trees, along the dykes, the fruit of which is protected from the ravages of bats by meshed wire netting, stretched from poles stuck into the mud of the ponds. The flight of the bats to the trees is thus checked. Li Chih Wan, Canton, China, June, 1915. Photograph (No. 1068-700) by the author.

PLATE XV, FIGURE 22. A view of the terraced hills, planted to fruit, at Lo Kang. The irregularly constructed steps along the sides of these hills are from fifteen to twenty feet wide and quite level. The sides of the steps, as seen by a man standing on each terrace, are perpendicular and from four to six feet high. Lo Kang, Kwangtung, China, April 9, 1919. Photograph (No. 31480) by the author.

PLATE XVI, FIGURE 23. The outer stockade built about the famous Kua lu lychee tree. With fruit worth \$24 per catty (one and one-third pounds) no chances are taken by the owners with thieves. This, the original Kua lu tree, is said to produce fruit of very superior quality and flavor. However, layers from the tree planted elsewhere are said to be far inferior to the original. The original tree is very old and in the days of the Empire all the fruit was sent to Peking or found its way into the hands of officials. Tseng Ch'ing, Kwangtung, China, June 28, 1918. Photograph (No. 31313) by the author.

PLATE XVI, FIGURE 24. In addition to the stockade (Fig. 23), enclosing the Kua lu lychee, there is an inner fence of bamboo. In addition to this protection against thieves, there is a fish-net thrown over the entire tree in order to protect the fruit from the attack of birds. It is reported that when the fruit is being picked from this tree it is customary for the owner to require pickers to sing in a loud voice, thus assuring that no fruit is being eaten. Tseng Ch'ing, Kwangtung, China, June 28, 1918. Photograph (No. 31316) by the author.

PLATE XVII, FIGURE 25. Upland orchard of lychee, revealing the tree, in shape and size not unlike that of apple. The magnificent culture of these trees of *Huai chih* variety as seen on these foothills establishes the fact that it is not necessary to grow this tree along the streams if the rainfall is sufficient during the fruiting season. Hsin T'ang, district of Tung Kuan, Kwangtung, China, March, 1917. Photograph (No. 1150) by the author.

PLATE XVIII, FIGURE 26. Lychee nurseries at the village of Fang Yung. Lychee trees are very tender, especially when young and the nursery plantings are protected from the cold winter winds by a magnificent hedge of mango trees. Fang Yung, Tung Kuan district, Kwangtung, China, March, 1917. Photograph (No. 1149) by the author.

PLATE XVIII, FIGURE 27. Fang Yung nurseryman in his orchard of specially selected and named trees, from which his nursery stock of lychee is propagated. Fang Yung, Tung Kuan district, Kwangtung, China, March, 1917. Photograph (No. 1148) by the author.

PLATE XIX, FIGURE 28. A pair of Ta tsao—Large crop—lychee as seen in the nursery village of Fang Yung, Tung Kuan district, Kwangtung, China, March, 1917. Photograph (No. 1147) by the author.

PLATE XIX, FIGURE 29. Mr. Chan P'eng Cheung, nurseryman of Fang Yung, seated under a beautiful specimen of lychee, the *Hsi chio tsu*—Rhinoceros horn—variety. Notice the vines and lichens growing along the trunk of the tree. Fang Yung, Tung Kuan district, Kwangtung, China, March, 1917. Photograph (No. 1146) by the author.

PLATE XX. An acid peaty soil better for the lychee than an ordinary fertile soil. On June 21, 1920, these two lychee plants were of similar size and condition of health. On January 11, 1921, when this photograph was taken, the condition of the two was conspicuously different. The vigorous healthy plant at the left had been growing for the seven months in an acid soil, consisting of two parts of upland peat to one of sand, while the weak unhealthy plant at the right had been growing for the same period in an ordinary rich soil made up of equal parts of loam, manure, and sand. (One-fifth natural size.) Photograph from Frederick V. Coville.

PLATE XXI. Healthy lychee root showing the mycorrhizal tubercles. This is a photograph (six times natural size) of a healthy root from a lychee plant grown in an acid peat-and-sand soil. The tubercles are gorged with mycorrhizal fungi. Plants grown in an ordinary rich soil are small and weak and bear no tubercles. Photograph from Frederick V. Coville.

PLATE XXII. Enlarged sections of lychee root tubercles showing the cells gorged with the mycorrhizal fungus. Microphotographs by Dr. Emil G. Arzberger.

FIGURE a. Median longitudinal section of a tubercle, showing the fungus mycelium in nearly all the cortical cells. (Magnification 195 diameters.)

FIGURE b. Two of the outer cortical cells of a tubercle, showing the form of the fungus mycelium. (Magnification 830 diameters.)

PLATE XXIII. Cells of lychee root tubercles containing the mycorrhizal fungus. Drawings by Dr. Arzberger with the aid of a camera lucida.

FIGURE a. Group of host cells from the outer part of the cortex, containing a relatively stout mycelium. (Magnification 775 diameters.)

FIGURE b. Group of host cells from the inner part of the cortex, showing a distorted host nucleus and the relationship of the branches of the mycelium to one another. (Magnification 775 diameters.)

FIGURE c. Host cell from the outer part of the cortex, showing a large nucleus and the presence of cytoplasm. (Magnification 775 diameters.)

FIGURE d. Group of inner cortical host cells, bordering on the vascular cylinder, showing the structure and relationship of the mycelial branches. (Magnification 500 diameters.)

PLATE XXIV, FIGURE 30. Reclaimed swampy land, planted to lychee. A clear illustration of the raised-bed system of orchard planting, Tung Kuan district, Kwangtung, China, March, 1917. Photograph (No. 1145) by the author.

PLATE XXIV, FIGURE 31. Scene of low-lying lychee groves, from substantially constructed bridge across a canal, Tung Kuan district, Kwangtung, China, March, 1917. Photograph (No. 1143) by the author.

PLATE XXV, FIGURE 32. Cantonese farmer at work along the dykes, fertilizing lychee trees with night soil. The fertilizer is carried in the buckets, from the boats (PLATE XXVI, FIGURE 34); small holes are dug near the base of the tree and a liberal quantity of this liquid fertilizer is poured into the holes. In the watery field on the left *sagittaria* is growing; in the field to the right the stubble remaining from the second crop of rice is seen. Near Canton, China, December, 1913. Photograph (No. 1026.242) by the author.

PLATE XXVI, FIGURE 33. A raised-bed plantation of lychee, showing holes dug in the beds, into which the liquid night soil is poured. Honan Island, Canton, China, March, 1917. Photograph (No. 1144) by the author.

PLATE XXVI, FIGURE 34. Unloading night soil boats for the fertilizing of lychee trees. Hundreds of these boats ply between Canton City and the country districts. The long bamboo handle on the dipper serves also as a pole on which to swing the two buckets when the man carries them, swung across his shoulder, to the dykes. Near Canton, China, December, 1913. Photograph (No. 1025.241) by the author.

PLATE XXVII, FIGURE 35. Lychee fruits arriving at the markets in Canton. The fruits are transported from the districts in the large, covered, bamboo baskets, in the passage boats seen in the photograph. The man, singing as he jogs along, is carrying two of these heavy baskets of fruit, one attached to each end of a large bamboo pole swung across his shoulder. Canton City, China, July, 1915. Photograph (No. 1077.739) by the author.

PLATE XXVII, FIGURE 36. Extensive nursery beds of lychee as seen at Fang Yung. These plants have all been "Chinese air-layered" from selected trees and planted closely together in nursery beds. Fang Yung, Tung Kuan district, Kwangtung, China, March, 1917. Photograph (No. 1142) by the author.

- PLATE XXVIII, FIGURE 37. The common method of raising the young lychee trees from their nursery beds. A ball of earth is kept intact with each tree raised, held in place by ropes of rice straw carefully bound about the earth before the tree is moved. A large, sharp chisel is used to raise the tree. Fang Yung, Tung Kuan district, Kwangtung, China, March, 1917. Photograph (No. 1141) by the author.
- PLATE XXVIII, FIGURE 38. The lychee trees are transported from the nurseries in boats, as seen in the illustration. Tung Kuan district, Kwangtung, China, March, 1917. Photograph (No. 1140) by the author.
- PLATE XXIX, FIGURE 39. Potted lychee on sale in the Hua Ti Gardens near Canton. Hundreds of these plants, sold under variety names, can be found in these world-famous gardens. Canton, China, June, 1915. Photograph (No. 1073.709) by the author.
- PLATE XXIX, FIGURE 40. Potted fruits are favorite ornaments of the Chinese. Small pots of fruiting lychee are not uncommon. Hua Ti Gardens, Canton, China, June, 1915. Photograph (No. 1072.708) by the author.
- PLATE XXX, FIGURE 44. A cluster of the famous No mi ts'z—Glutinous rice—lychee, from a layered plant. (One-half natural size.) Lo Kang, Kwangtung, China, June, 1920. Photograph (No. 1349) for the author.
- PLATE XXX, FIGURE 46. A cluster of Hsiang li or Fragrant lychee from Sin Hing district, Kwangtung. (About one-third natural size.) The fruits are deep red in color, with a roughened surface. They are quite fragrant. Canton, China, summer, 1915. Photograph (No. 1136) for the author.
- PLATE XXXI, FIGURE 42. The most conspicuous insect enemy of the lychee—a highly decorated species of Pentatomidæ, *Tessaratomia papillosa*. The winged adults, lychee-colored nymphs, and hatched and unhatched eggs are all shown about natural size. Ling Nan (Canton Christian College), Canton, China, summer, 1915. Photograph (No. 1139) by the author.
- PLATE XXXII, FIGURE 41. An ingenious method of killing the lychee tree borer. Cantonese farmer, standing in the fork of the tree, shooting "hisser" firecrackers into the holes which the larvæ have bored in the branches of the tree. Near Canton, China, January, 1914. Photograph (No. 1035.306) by the author.
- PLATE XXXII, FIGURE 43. The trunk of a lychee tree showing the work of the lychee borer and lichens growing over the bark. The sight of both is very common. Near Canton, China, June, 1915. Photograph (No. 1065.701) by the author.
- PLATE XXXIII, FIGURE 45. A natural size and natural color reproduction of the inarched type of No mi ts'z variety of lychee as produced at Lo Kang, Canton, China, summer, 1915. Photograph (No. 1137) for the author.
- PLATE XXXIV, FIGURE 47. The original parent tree of a famous variety of lychee, the Hsi chio tsu—Sai kok tsz—or Rhinoceros horn. In the Tseng ch'ing district the fame of this variety is next to that of the Kua lu or Hanging-green (see PLATE XVI). Liu ts'un, Tseng ch'ing district, Kwangtung, China, June 29, 1918. Photograph (No. 31330) by the author.
- PLATE XXXIV, FIGURE 48. View of the entire "Rhinoceros horn" tree, the trunk of which is shown in FIGURE 47. In the Tseng Ch'ing district this variety ranks third in earliness. Some idea of the size of this tree may be made by comparing it with the people standing along the road. This tree had a spread of head of more than sixty feet. The forked trunk, breast high, had a total circumference of twelve feet. Liu Ts'un, Tseng Ch'ing district, Kwangtung, China, June 29, 1918. Photograph (No. 31329) by the author.

- PLATE XXXV, FIGURE 49. The Hei yeh (Hak ip) or Black-leaf variety. (One-half natural size.) Fruit from Tseng Ch'ing district, Kwangtung, China, June, 1920. Photograph (No. 1327) for the author.
- PLATE XXXV, FIGURE 50. The Fei tsu hsiao (Fi tsz siu) or Imperial concubine's laugh. (One-half natural size.) Fruit from Pei Shan, Pan Yu district, Kwangtung, China, June, 1920. Photograph (No. 1325) for the author.
- PLATE XXXVI, FIGURE 51. The Ch'u ma tsu (Chu ma tsz) or Chinese grass fiber variety. (One-half natural size.) Fruit from Lo Kang, Kwangtung, China, June, 1920. Photograph (No. 1339) for the author.
- PLATE XXXVI, FIGURE 52. The Huai chih (Wai chi) lychee, as it appears on the Canton markets under the name of Hei yeh or Black-leaf. (About three-fourths natural size.) Canton, China, June, 1915. Photograph (No. 1135) for the author.
- PLATE XXXVII, FIGURE 53. The San yueh hung (Sam ut hung) or Third month red lychee. (About two-thirds natural size.) Canton, China, May, 1915. Photograph (No. 1130) for the author.
- PLATE XXXVII, FIGURE 54. Fruit and leaves of the Shan chih (Shan chi) or Mountain lychee. (About one-third natural size.) This is one of the wild forms found growing in Kwangtung. The fruit invariably contains large seeds, and the flesh, which is thin, is very sour. The seed germinates readily, if planted shortly after removal from the fruit, and the seedlings are vigorous. In Lo Kang and other regions this type is often used for stock on which to graft or inarch the No mi ts'z and other varieties. Tseng Ch'ing district, Kwangtung, China, June 29, 1918. Photograph (No. 31331) by the author.
- PLATE XXXVIII, FIGURE 55. The Chuang yuan hung (Chong un hung) lychee, not a commercial variety but nevertheless quite popular. (Two-thirds natural size.) Fruit from Pei Shan, Pan Yu district, Kwangtung, China, June, 1920. Photograph (No. 1323) for the author.
- PLATE XXXIX, FIGURE 56. Magnificent specimen of a lungan tree near a temple along the road extending from the East Gate of Tseng Ch'ing city to Liu Ts'un. This tree was variety Yau yen (Yau ngan) or Soft lungan. It was forty feet high with a spread of head of sixty feet. The trunk, breast high, had a diameter of two feet, eight inches and a circumference of eight feet. Liu Ts'un, Tseng Ch'ing district, Kwangtung, China, June 29, 1918. Photograph (No. 31319) by the author.
- PLATE XXXIX, FIGURE 57. The fruiting head of a fine specimen of lungan tree. Tseng Ch'ing district, Kwangtung, China, June 29, 1918. Photograph (No. 31320) by the author.
- PLATE XL, FIGURE 58. Mr. Kwok Wa Shau, with potted lungan seedling fourteen months old. The tree is a U un (Wu yuan) or Black ball variety, commonly used for stock. Ling Nan (Canton Christian College), Canton, China, November, 1919. Photograph (No. 31547) for the author.
- PLATE XLI, FIGURE 59. A fruiting cluster of the U un (Wu yuan) or Black ball lungan. (About two-fifths natural size.) This is the variety commonly used for stock. The fruit is edible but inferior to other varieties. Fruit from Pan Yu district, Kwangtung, China, July, 1918. Photograph (No. 31362) for the author.
- PLATE XLI, FIGURE 60. A cluster of She p'i or Snake skin lungan. (About two-thirds natural size.) This is one of the largest of the lungan, and, like all other varieties, has large seeds. Shih Wei T'ang, near Canton, China, July, 1918. Photograph (No. 31363) for the author.

APPENDIX XI

SUPPLEMENTARY NOTES

Page 7, footnote 3. For date and place of publication see page 28, footnote 2.

Page 12. In a literal sense the words "Ling Nan" mean "South of the Range," a term used for Kwangtung and Kwangsi. According to Giles Chinese-English Dictionary "Ling" means a mountain range, and "Nan" means south. And according to the same author the range to which reference is made in the expression is the "Mei or Plum" range of mountains in the northeast of Kwangtung.

Page 13. It is worth observing that Ts'ai Hsiang and Wu Ying K'uei did not agree in the use of the "wood" radical in writing the Chinese word representing the sound "chee." Ts'ai Hsiang always used the radical and in the frequent references to his "Li Chih P'u" in this work it has been incorrectly omitted.

Page 16, footnote 1. Various rubbings and copies of the *Li Chih P'u* by Ts'ai Hsiang have been in circulation but are now difficult to obtain. It has not only been reprinted in *Ku Chin T'u Shu Chi Ch'eng* (see page 18) but also in the *Chih Wu Ming Shih T'u K'ao* (see page 21 and No. 11, page 120). This monumental economic botany of China contains no fewer than 1714 excellent plates about $9\frac{1}{4}$ by $5\frac{3}{4}$ inches, and each accompanied by a concise description of the plant figure. The historical part of the work gives a full account of 838 plants. A third edition was printed from the original blocks in 1919 by the Provincial Printing Office of Shansi at Taiyüanfu. A smaller reprint of this work, published in Western style and bound in two volumes with the English catch-title, "Readings in Chinese Plants," was issued in 1919 by Commercial Press, Ltd., of Shanghai. In this edition the plates are $3\frac{1}{4}$ by 2 inches. The Chinese stroke index to Chinese names of plants greatly facilitates ready reference. Six treatises on the lychee are reprinted in the *Chih Wu Ming Shih T'u K'ao*, including the original one by Ts'ai Hsiang. These are Nos. 3, 5, 6, 7, and 8 recorded in the bibliography, pages 119 and 120, and a monograph, *Chi Li Chih* by Wu Tsai Ao, not included in the bibliography but cited on page 75, first paragraph and footnote one.

Translations of these and other treatises by Mr. Hagerty and Mr. Ch'en may be secured by arrangement with the Library of the United States Department of Agriculture, Washington, D. C.

Page 18, paragraph 2 and footnote 2a. According to Giles, the author's name is spelled "Chi Han"; but Bretschneider spells it "Ki Han."

Page 20, line 4. Insert the name of Mr. Ch'en Tsing-hua after that of Mr. Michael J. Hagerty.

Page 40. This synonymy of *Euphoria longana*, outlined by Karl Ludwig Blume (see page 129, No. 114), is subject to correction and revision. It includes some non-botanical names and is confusing.

Page 68, paragraph 2. It should be noted that lychee grafted on the lungan in Hawaii has proved to be short lived.

Page 88. Insert footnote 3—Cheshire, F. D., in Plant Immigrants, Office Foreign Seed and Plant Introduction . . . (see Page 137, No. 188).

Page 119, No. 1. Ch'en T'ing's treatise will be found in *Chao Tai Ts'ung Shu*, section 48, Chia Chi, pages 1-10. Lib. Cong. C338.51(83).

Page 119, No. 2. Ch'en Ting Kuo's treatise will be found in *Chao Tai Ts'ung Shu*, section 48, Keng Chi, pages 1-8. Lib. Cong. C338.51(83).

Page 119, No. 4. Lin Ssu Huan's treatise will be found in *T'an Chi Ts'ung Shu*, section 50, pages 1-5. Lib. Cong. C338.5(80).

Page 120. To the nine standard works on the lychee listed here should be added the following three additional ones:

Wu Tsai Ao, *Chi Li Chih*. See page 75, footnote 1.

T'u Pen Tsun, *Li Chih P'u*. See Bretschneider *Botanicon Sinicum*, 1: 168. Preface only in the Imperial Encyclopedia.

Huang Li Keng, *Li Chih P'u*. See Bretschneider *Botanicon Sinicum*, 1: 168. Not found.

Page 129, No. 118a. Bretschneider, Emil Vasilievich, 1833-1901, *Botanicon Sinicum* I. Notes on Chinese Botany from Native and Western Sources in *Journal of the North China Branch of the Royal Asiatic Society*. 1881. New Series. Vol. XVI, Part 1, Shanghai. Printed by Noronha & Sons, No. 12 Canton Road, 1882, pages 167 and 168.

Page 130, 122a. Cheshire, F. D., in *Plant Immigrants* (see 137, No. 188).

Page 143. Note that the Cantonese names appear in the first column and the Mandarin in the second.

POSTFACE

This compilation of knowledge concerning the lychee and lungan is western in form but Chinese in spirit. Therefore it does not seem out of place to follow Chinese usage and to attach a postface. This gives the writer an opportunity to explain some things that would otherwise remain a mystery.

The original body of the work and five appendices, pages 1 to 149, were printed on the College Press, Canton Christian College, Canton, China, where it was possible to insert Chinese characters. The work went to press about the time the writer was leaving for an extended trip to Siam, and consequently he had no opportunity to read the proof or to revise the work as it went through the press. Early in 1921 the unbound sheets were sent to the United States.

There has been considerable advance in the scientific study of the lychee during recent months. Credit is due Dr. Frederick V. Coville for the discovery of mycorrhizal fungi growing on the roots of lychee. Dr. Coville's article, well illustrated with drawings and microphotographs by Dr. Emil G. Arzberger, suggests the probability that an acid soil is essential for successful culture of the lychee. Chinese methods of propagating the lychee have never been highly satisfactory. Mr. Edward Goucher has finally worked out a most unusual process for rooting lychee cuttings that may not only revolutionize lychee propagation, but also that of other sub-tropical and tropical plants. Acknowledgment is due Mr. Goucher for his experiments and his explanation of the process as worked out with the lychee. Mr. Walter T. Swingle's statement of his observations on the Lack of Winter Dormancy and Low Zero Point of Growth of the Lychee should prove helpful in the culture of the lychee in Florida. Mr. Swingle also suggests the possibilities of the lychee as an attractive greenhouse plant. This is also the conviction of a number of observers who have seen the lychee in its native home.

Mr. Michael J. Hagerty's clear translation, recording the

organization of a Lychee Club as early as the Ming dynasty, will prove of unusual interest.

The additional material, pages 151 to 188, and all the illustrations were printed at the Mount Pleasant Press, J. Horace McFarland Company, Harrisburg, Pa., in June, 1921. A portion of the edition will be bound in the United States, but copies for distribution in the Orient will be assembled and bound in China.

We are only on the threshold of an understanding of this interesting and valuable fruit. A scientific lychee culture is essential to China and is of interest to the West. The industry should be systematically developed in China and foreign markets created for the canned and dried products. It is the writer's hope that in the near future the Chinese will work out the scientific phases of lychee culture as well as they have the historical and literary lore of this most highly prized fruit.

G. WEIDMAN GROFF.

Washington, D. C., U. S. A.

June 22, 1921.

ERRATA

- Page 10, paragraph 3. For *No Mi Chih* read *No mi ts's*.
 Page 16, footnote 1. For *future time* read *past time*.
 Page 17, footnote 1. Cancel *Emil Vasilievich*.
 Page 18, paragraph 2, line 3. Cancel *the*.
 Page 18, footnote 2a, line 1. For *bear* read *bearing*.
 Page 18, footnote 2b, last line. For 47 read 54.
 Page 37, line 3. Cancel *Laetia chinensis* Osb. Itin. (1765) from the synonymy. Osbeck in his *Dagbok ofwer en Ostindisk Resa* . . . (1757), translated into the German in 1765 and from the German into English in 1771, refers to the lychee as from China but does not give a Latin name as he does in the case of other plants he recorded. This name is therefore not a valid synonym.
 Page 45, paragraph 2. For *sagitaria* read *sagittaria*.
 Page 50, paragraph 2. For *No mi chih* read *No mi ts's*.
 Page 52, paragraph 2. For *Sin T'ang* read *Hsin T'ang*.
 Page 53, paragraph 1. Same correction as page 50, paragraph 2.
 Page 58, paragraph 2, line 3. For *trees therefore* read *trees are therefore*.
 Page 59, paragraph 1, line 8. For *fifteen wide* read *fifteen feet wide*.
 Page 59, paragraph 2, line 2. For *is* read *in*.
 Page 61, paragraph 1, line 1. For *maintain the* read *maintain that the*.
 Page 61, paragraph 2, last line. Cancel (fig. 40).
 Page 64, paragraph 2, line 3. Cancel 92.
 Page 66, paragraph 1, line 5. For *No mi chih* read *No mi ts's*.
 Page 66, paragraph 1, last line. For (fig. 18) read (fig. 38).
 Page 67, paragraph 1, line 7. Cancel 92.
 Page 67, paragraph 2, line 3. For *No mi chih* read *No mi ts's*.
 Page 85, paragraph 2, line 9. For (fig. 47) read (fig. 41).
 Page 88, paragraph 2, line 1. For *Sung Yu* read *Sung Chio*.
 Page 93, paragraph 2, line 12. For *these* read *there*.
 Page 95, paragraph 1, line 4. For *rhinoceros* read *rhinoceros*.
 Page 96, line 21. For *Shang hou huai* read *Shang shou huai*.
 Page 98, paragraph 2, line 4. For (fig. 33) read (fig. 53).
 Page 100. Brackets should not extend below "Weight of rag (oz)."
 To secure the total of 16 ounces to the pound of fruit add only weight of seeds, flesh, skin, leaves and stem. The weight of rag is included in the weight of flesh.
 In the "No mi ts's" column across from "Weight of rag" some error occurs in the statement "6 1/2." It should probably be "1 1/2" but could not be verified at time of correction.
 Page 107. Title at the top of page. For *The Lychee* read *The Lungan*.
 Pages 108 and 109. Subject to the same explanation and correction as recorded under pages 100 and 101.
 Some error exists in the case of the weights recorded under "Hei ho shih hsia" lungan as the total of seeds, flesh, skin, leaves and stem is 15 instead of 16 ounces. No change can be made as original records were not available at time of correction.
 Page 116, paragraph 1, line 1. Cancel *and*.
 Page 119, No. 4. For *Li Chih P'u* read *Li Chih Hua*.

INDEX

- Acid-soil, 151, 152, 167, Pl. XX.
Adoretus convexus Burm., insect enemy, 83.
Adoretus tenuimaculatus, insect enemy, 85.
 Africa, 34.
Ai chih, Chinese term for inarching, 67.
 Air-layering, 9, 10, 49, 53, 64-67, 91, 117, 168, Pl. XXVII.
Alapag, Philippine lychee relative, 26, 41.
 Algæ, 86.
 American literature, 23-31.
 Amory, Charles, Florida grower, 112.
 Analytical table, lychee varieties, 100, 101; lungan varieties, 108, 109.
A neung hai, variety of lychee, 50, 99, 143.
 Annals,
 Fukien, 121, 122; cited, 88.
 Kwangsi, 122.
 Kwangtung, 122-126; cited, 88.
 Kweichow, 122.
 Szechwan, 122.
Anomala varicolor Gyll., insect enemy, 83.
Archips postvittatus, insect enemy, 85, 86.
 Arzberger, Dr. Emil G., acknowledgment drawings and microphotographs by, 152, 167, Pl. XXII, 168, Pl. XXXIII, 173.
 Ashon, John, importer of lychee, 113.
Autoserica nigrorubra Busk., insect enemy, 83.
 Baillon, Henry Ernest, cited, 33.
 Bamboo, 52.
 Banana, 58.
 Baskets, marketing, 166, Pl. XII, 168, Pl. XXVII.
 Bats, 63, 82, 86, 166, Pl. XV, Pl. XVI.
 Badana, Indian variety of lychee, 102.
 Bengal, 111.
 Bibliography—
 Chinese references, 119-126, 171, 172.
 Western references, 127-141.
 Big bull, variety of lychee, 144.
 Black ball, variety of lungan, 110, 145, 170, Pls. XL, XLI.
 Black leaf, variety of lychee, 95, 143, 170, Pl. XXXV.
 Black seed stone gorge, variety of lungan, 145.
 Blasdale, Walter C., quoted, 149.
 Blume, Karl Ludwig, cited, 40, 171.
 Bonavia, Dr., quoted, 118.
 Borer, tree, 85, 169, Pl. XXXII.
 Borneo, 69.
 Botany, 32-43.
 lychee, 37-39
 lungan, 40-42
 Boym, Michel, cited, 25.
 Bretschneider, E. V., cited, 17, 19, 171, 172; quoted, 18.
 Brewster, Rev. W. N., importer of lychee, 112.
 Buddhism, 93, 94.
 Budding, 10, 68.
 Burma, 39.
 Bursts the throat, variety of lychee, 143.
 By-Laws, Lychee Club, 162, 163.
 Calcutta, 111.
 California, 6, 8, 57, 72, 112, 114, 118.
 Cambell, George, quoted, 57.
 Cambell, George Joseph, cited, 26.
 Campbell, Rev. Wm., quoted, 77.
 Canal mud, use of, 105.
 Canals, 48, 52.
Canarium, 50, 52.
 album (Lour.) Raench, 50.
 pimela, Koen, 50.
 Candolle, Alphonse, cited, 29, 30.
 Canned lychee and lungan, 5, 75, 80, 110.
 Canton—
 city, 46, 47, 48, 89.
 climate, 54, 55, 142, 153-155.
 climate compared with Florida, 153, 155.
 delta, 45, 46, 54, 56, 59, 60, 165, Pl. VIII.
 Kowloon Railway, 49, 51, 52.
 latitude, 153.
 location, 48, 153.
 markets, 71, 89, 92, 99.
 public fruit park, 47, 48.
 restaurants, 75.
 weather, 54, 55, 142, 153-155.

- Canton Christian College, 1, 12, 21, 46, 82, 83, 85, 113, 153, 165, Pls. VIII, IX, XI, 166, Pls. XII, XIII, XIV, 169, Pls. XXXI, 170, Pl. XL.
- Cantonese, 89.
- Capnodium*, fungus, 86.
- Carambola, 48.
- Carter, Humphrey G., cited, 60.
- Castanopsis mollissima*, Bl., 50.
- Chafers, leaf, 83.
- Ch'ang An, transportation of lychee to, 87.
- Changchow, prefecture in Fukien, 88.
- Ch'ang pau hau*, variety of lychee, 99, 143.
- Ch'an Ts'un, village, 95.
- Ch'an tsz*, variety of lychee, 102, 164, Pl. I.
- Ch'au p'i tan*, insect enemy, 82.
- Chau shiu yuk*, variety of lychee, 143.
- Check, Ching, first introduction into Hawaii, 112.
- Chemical analysis, lychee, 80, 81, 149.
- Chen family purple, class of lychee, 88, 164, Pl. I.
- Cheng Hsiung, cited, 88.
- Cheng pao hau*, variety of lychee, 99, 143.
- Ch'eng T'ang, Emperor, B. C. 1766, 17.
- Ch'en T'ing, Li Chih P'u, 119, 171.
- Ch'en Ting Kwo, Li Chih P'u, 119, 171.
- Ch'en Ts'ing-hua, assistance acknowledged, 160, 171.
- Ch'en Ts'un, village, 95.
- Ch'en tsu*, variety of lychee, 102, 164, Pl. I.
- Cheshire, F. D., cited, 88, 171, 172.
- Cheung Lok, 56.
- Chia huai*, variety of lychee, 99, 143.
- Chiang chun li*, variety of lychee, 50, 144.
- Chiao T'ang Sz, lychee region, 49, 65, 104.
- Chia Ssu Hsieh, cited, 19.
- Chi Han, cited, 62, 171.
- Chih Kang, lungan region, 104.
- Ch'ik Kong, lungan region, 104.
- Child's fist, variety of lychee, 144.
- Chih Wu Ming Shih T'u K'ao, cited, 21, 171.
- Chi Li Chih by Wu Tsao Ao, cited, 75, 172.
- China, Indian variety of lychee, 102.
- China grass fiber, variety of lychee, 97, 143, 170, Pl. XXXVI.
- Chinese—
- air-layering, 10, 49, 53, 64-67, 91, 117, 168, Pl. XXVII.
- bibliography, 119-126.
- Collection in Library of Congress, 23, 22, 164.
- descriptive terms, 90, 91.
- gardeners, 65, 66.
- Imperial Encyclopedia, 160, 164, Pl. IV.
- literature, 16-22, 104.
- nurserymen, 2, 65, 167, Pls. XVIII, XIX.
- nut, 5, 32.
- officials, 7.
- poets, 7, 16, 19, 116.
- treatises on the lychee by—
- Ch'en T'ing, Li Chih P'u, 119, 171.
- Ch'en Ting Kwo, Li Chih P'u, 119, 171.
- Cheng Hsiung, title not known cited, 88.
- Hsu P'o, Li Chih P'u, 119; quoted, 56, 68, 75, 114.
- Huang Li Keng, Li Chih P'u, 172.
- Lin Ssu Huan, Li Chih Hua, 119, 171.
- Sung Chio, Li Chih P'u, 119; cited, 20, 56, 66, 88; translated in part, 160-163.
- Tang Tao Hsieh, Li Chih P'u, 119; cited, 60, 61, 67.
- Ts'ai Hsiang, Li Chih P'u, 2, 11, 120, 164, Pl. III, Pl. IV, 171; cited, 16, 17, 20, 62, 63, 66; quoted, 56, 72, 88, 115.
- Ts'ao Fan, Li Chih P'u, 120.
- T'u Pen Tsun, Li Chih P'u, 172.
- Wu Tsao Ao, Chi Li Chih, 75; cited, 75, 172.
- Wu Ying K'uei, Ling Nan Li Chih P'u, 120; quoted, 2, 11; cited, 13, 17, 31, 87, 88, 106, 107, 171; list of Kwangtung varieties, 146-148.
- writers, 7, 22, 82, 87, 116, 117.
- Chin feng li*, variety of lychee, 144.
- Ch'ing p'i*, variety of lychee, 144.
- Ch'i Nu, pseudonym for Shih Ch'ung, 161.
- Ch'i yueh shou*, variety of lychee, 144.
- Chong un hung*, variety of lychee, 99, 143, 170, Pl. XXXVIII.

- Ch'ou p'i tan*, insect enemy, 82.
 Chou Shao Yu, variety of lychee, 143.
 Chuanchow, prefecture of Fukien, 88.
Chuang yuan hung, variety of lychee, 99, 143, 170, Pl. XXXVIII.
Ch'u ma tsu, variety of lychee, 97, 143, 170, Pl. XXXVI.
Chu ma tsz, variety of lychee, 97, 143, 170, Pl. XXXVI.
 Chung-hsiang Kung, Ts'ai Hsiang's canonization title, 164.
 Chun-mo, Ts'ai Hsiang's literary name, 164.
 Cienfuegos, Cuba, latitude compared, 154.
 Cinnamon flavor, variety of lychee, 93, 143.
 Citrus, 48, 65.
Citrus aurantifolia, (Christm.) Swing., 156.
 Climate—
 adapted to lychee and lungan, 54-57.
 Canton compared with Florida, 153, 155.
 Seharanpur, 56.
 Cloth bag, variety of lychee, 143.
 Club, lychee, 160-163.
 Cochin China, 44, 87.
 Cockroach, variety of lychee, 143.
 Cocconut palms, 153, 154.
 Cold, ill effects, 55, 56, 114, 115; protection, 60, 61; resistance, lungan, 58, 103.
 Cole, W. B., quoted, 105, 106, 107.
 Collins, G. N., quoted, 111.
 Color, lychee, 100, 101; lungan, 108, 109.
 Commerce, 7, 12, 71.
 Cook, O. F., quoted, 111.
 Corsa, W. P., cited, 30.
 Coville, Frederick V., acknowledgment, 173; contribution by, 151; reference to work of, 156.
 Crisp meat lungan, variety name, 145.
 Crop watchers, 46, 165, Pl. XI.
Cryptophlebia illepidia, insect enemy, 85.
 Crystal quartz ball, variety of lychee, 144.
 Cuba, 72, 113.
 Culture, 58-63.
 dyke, 58, 117.
 greenhouse, 156.
 hill type of lychee, 49, 50.
 in Florida, 153.
 Culture—
 lychee, 48-50, 114, 116, 117.
 methods, lungan, 104-106.
 raised-bed, 59, 117.
 upland, 59, 117, 167, Pl. XVII.
 water type of lychee, 48, 49.
 Cuttings, 10, 157-159.
 Dapper, Olfert, cited, 25, 26.
 Dehiscent fruits, 35.
 Dehra Dun, India, 56.
 Delta, Canton, 45, 46, 54, 56, 59, 60, 165, Pl. VIII; Pearl river, 58.
 Description—
 lychee, 37, 38, 39.
 lungan, 41, 42, 103.
 terms, 90, 91.
 Dews, value of, 60.
Dimocarpus, 8, 28, 29.
Diospyros kaki L., 50.
 Diseases, 82, 114, 117.
 Dishes, lychee, 75.
 Distance for planting, 58, 59.
 Ditches, 48.
 Door-yard tree, lungan, 104.
 Don, George A., cited, 33.
 Dragon eye, 5, 15, 103.
 Dried, 5, 50.
 lychee, 75, 76, 78, 79.
 lungan, 77.
 Drought resistance, 11, 69.
 Dudhia, Indian variety of lychee, 102.
 DuHalde, J. B., cited, 26.
 Duncan, K., acknowledgment, 3.
 Dykes, 45, 48, 58, 165, Pls. VI, VII, VIII, IX, X, XI.
 Early lychee, variety name, 144.
 Early rice, variety of lungan, 145.
 East Indies, 6, 29, 32.
 East river, 45, 52.
 Edwards' Botanical Register, cited, 29.
 Enemies, 9, 82-86.
 England, 29, 111.
Eriophyes, lychee leaf galls, 84, 85, 164, Pl. V.
Euphoria, 6, 32, 69, 70.
 cinerea, Radlk., 11, 26, 34, 41, 70, 164, Pl. V.
 longana, Lam., 5, 34, 41, 70, 171.
 Europe, 111, 116, 117.
 European literature, 23-31.
 Exchange, influence of, 74.

- Experiments, lychee, 69; needed, 11, 116; rooting lychee cuttings, 157, 158; soil, 151.
- Exports, 50, 52.
- Fa hok*, variety of lungan, 73, 106, 108, 110, 145.
- Fairchild, David, acknowledgment, 2.
- False *wai*, variety of lychee, 143.
- Fang huang ch'iu*, variety of lychee, 143.
- Fang Kang, place in Fukien, 61.
- Fang Tsu-tao, friend of Sung Chio, 160.
- Fang Yung, lychee nursery village, 52, 53, 65, 167, Pl. XVIII, Pl. XIX, 168, Pl. XXVII, 169, Pl. XXVIII.
- Fat meat ball, variety of lungan, 145.
- Fei tsu hsiao*, variety of lychee, 95, 96, 143, 170, Pl. XXXV.
- Feng li*, chestnut, 50.
- Feng wan*, Chinese synonym for lychee, 17.
- Fertilizing, 61, 105, 106, 117, 168, Pl. XXV, Pl. XXVI.
- Firecrackers, use of, 85, 169, Pl. XXXII.
- Fish, 45, 165, Pl. VIII.
- Ki tsz siu*, variety of lychee, 95, 96, 143, 170, Pl. XXXV.
- Flavor, lychee, 91, 100, 101, 111, 156; lungan, 108, 109.
- Flesh, lychee, 90.
- Fletcher, S. W., acknowledgment, 2.
- Florida, 6, 8, 30, 57, 60, 72, 113, 114, 118, 153; weather compared, 155, 156.
- Flower skin, variety of lungan, 110, 145.
- Flush of lychee, 54, 153.
- Flying riders, tribute bearers, 87.
- Foochow, prefecture of Fukien, 72, 88, 107.
- Food value, 80.
- Foreign Seed and Plant Introduction, Office of, 2, 8.
- Foreign trade, 79.
- Form, lychee, 90, 100, 101; lungan, 108, 109.
- Formosa, 39, 44, 77.
- Fortune, Robert, quoted, 29.
- Foster, I. L., acknowledgment, 2.
- Fragrance, lychee, 91.
- Fragrant variety of lychee, 93, 143, 169, Pl. XXX.
- France, 111.
- Freeman Meteorological Observatory, 153.
- Freeze, 54, 56, 57.
- Frost resistance, lychee, 11, 30, 54, 56, 57, 69, 82; lungan, 54, 56, 57.
- Frost protection, 114.
- Fruit park, Canton, 47, 116.
- Fruit worm, 85.
- Fuchow, 56.
- Fukien, province, 11, 32, 44, 68, 87, 88, 96, 104, 116.
- Fung Chung, lychee nursery village, 52, 53, 65, 167, Pls. XVIII, XIX, 168, Pl. XXVII, 169, Pl. XXVIII.
- Fungicides, 82.
- Fungi, 86.
- Fungi, mycorrhizal, 152, 167, Pls. XXI, XXII, 168, Pl. XXXIII.
- Fung Kong, in Fukien, 61.
- Fung lut*, chestnut, 50.
- Fung wong k'au*, variety of lychee, 143.
- Galls, leaf, 84, 85.
- Gardeners, Chinese, 65, 66.
- Gazetteers, see Annals.
- General's lychee, variety name, 144.
- Georgeson, C. C., cited, 30.
- Glutinous rice, variety of lychee, 91, 99, 100, 143, 169, Pls. XXX, XXXIII.
- Glutinous rice ball, variety of lychee, 143.
- Gonzalez de Mendoza, Juan, quoted, 23.
- "Gootee" layering, 10, 64.
- Goucher, Edward, acknowledgment, 173; contribution by, 157-159.
- Gracey, Samuel L., shipment received from, 113.
- Grafting, 10, 49, 50, 68, 106, 157, 171.
- Grave land, use of, 83.
- Greenhouse culture, lychee, 156, 173.
- Green skin, variety of lychee, 144.
- Grosier, J. B. G. A., quoted, 27, 28.
- Group, lychee, 34-36, 69.
- Guam, 113.
- Guava, 48, 58, 59, 156.
- Habitat, lychee, 11, 39, 54; lungan, 42, 54.
- Ha chi*, Chinese season, 95.
- Hadley, E. D., California grower, 112.
- Hagerty, Michael J., translations acknowledged, 2, 17, 20, 171, 173; translation by, 160-163.
- Hainan, 19, 39, 44.
- Hak hai shek hap*, variety of lungan, 108, 145.

- Hak ip*, variety of lychee, 64, 73, 89, 95, 97, 100, 101, 143, 170, Pl. XXXV.
- Hanging green, variety of lychee, 50, 92, 143, 166, Pl. XVI.
- Han Wu Ti, Emperor, reference to, 87.
- Han Yen Chih, monograph on orange, 16.
- Harvesting, 63.
- Havana, Cuba, compared with Canton, 153.
- Hawaii, 6, 31, 67, 68, 70, 72, 85, 112, 117, 118.
- Hei ho shih hsia*, variety of lungan, 108, 145.
- Hei yeh*, variety of lychee, 64, 73, 89, 95, 97, 101, 143, 170, Pl. XXXV.
- Henry, Alfred J., cited, 155.
- Henry, Augustine, quoted, 7.
- Henry, B. C., cited, 94.
- Heung lai*, variety of lychee, 93, 143, 169, Pl. XXX.
- Heungshan, district in Kwangtung, 98.
- Hiern, W. P., cited, 43.
- Higgins, J. E., 10, 11; cited, 15, 31, 64, 67, 75, 85, 86, 102; quoted, 68, 72, 84, 85, 112; shipment received from, 113.
- Hill lychee, 52.
- Hill type of lychee culture, 49, 50.
- Hingwa, prefecture of Fukien, 88, 105.
- Hit and kill the cow, variety of lychee, 144.
- Ho Hung, P'ing, acknowledgment, 2, 21.
- Holotrichia plumbea planicollis* Burm., 83.
- Honam, island opposite Canton, 48, 164, Pls. II, X, 168, Pl. XXVI.
- Honan. See Honam.
- Hongkong, 39; climate, 154.
- Hooker, Sir Joseph Dalton, cited, 33.
- Hoplosternus chinensis* Guer., insect enemy, 83.
- Ho Ti, proclamation of, 18.
- Howard, C. W., 85; quoted, 82, 83.
- Howard, L. O., cited, 84.
- Hsia chih*, Chinese season, 95.
- Hsiang li*, variety of lychee, 93, 94, 143, 169, Pl. XXX.
- Hsiao erh ch'uan*, variety of lychee, 144.
- Hsi chio tsu*, variety of lychee, 53, 94, 95, 143, 167, Pl. XIX, 169, Pl. XXXIV.
- Hsinghwa, Fukien, latitude, 153; lychee region, 11.
- Hsu P'o, Li Chih P'u, 119; quoted, 56, 68, 75, 114.
- Huai chih*, variety of lychee, 46, 51, 64, 66, 73, 79, 89, 92, 96, 97, 98, 101, 144, 165, Pl. XI, 166, Pl. XII, 167, Pl. XVII, 170, Pl. XXXVI.
- Hua kioh*, variety of lungan, 73, 106, 108, 110, 145.
- Huang ch'ung*, insect enemy, 83.
- Huang Li Keng, Li Chih P'u, 172.
- Huang Tsun Keng, acknowledgment, 55.
- Hua Ti Gardens, 169, Pl. XXIX.
- Hui Tsung, Sung Emperor, 164.
- Humidity, 55, 66, 64.
- Humidity, high for rooting lychee, 157, 158.
- Huo shan*, variety of lychee, 162.
- Hu pi* (tiger skin), class of lychee, 88.
- Hybridization, 6, 11, 41, 42.
- I chih*, Chinese synonym of lungan, 104.
- Imperial concubine's laugh, variety of lychee, 95, 143, 170, Pl. XXXV.
- Inarching, 10, 67, 106, 157.
- Indehiscent fruits, 34, 35.
- India, 6, 31, 32, 54, 56, 81, 111.
- Indian varieties, 102.
- Irrigation, 59.
- Insect enemies, 82-86, 114, 117.
- Insecticides, Chinese use of, 82.
- Insect protection, 62, 63.
- Insects, chicken food, 83.
- Intercropping, 58, 59.
- Introductions to—
- Bengal, 111.
 - Burma, 39.
 - California, 6, 112, 118.
 - Cuba, 113.
 - East Indies, 111.
 - England, 29, 111.
 - Europe, 111, 116, 117.
 - Florida, 6, 30, 113, 118.
 - France, 111.
 - Guam, 113.
 - Hawaii, 6, 31, 112, 117, 118.
 - India, 6, 31, 111.
 - Isle of Pines, 113.
 - Other lands, 1, 7, 8, 11.
 - Panama, 6, 113.
 - Porto Rico, 111, 113.
 - Trinidad, 113.
 - United States, 112, 113, 117, 118.

Introductions to—

- Western Hemisphere, 32.
 West Indies, 6, 111, 117, 118.
 Isle of Pines, 113.
 I Yin, cited, 17.
 Jade ice, variety of lychee, 144.
 Jade purse, variety of lychee, 144.
 Java, 6.
 Jones, J., interest in Dominico, 112.
 Jonstonus, Johannes, cited, 25.
 Josselyn, Vice Consul, quoted, 81.
 Juice, lychee, 100, 101; lungan, 108, 109.
Kao yuan, variety of lungan, 73, 109, 110, 145.
Kai tsai chi, variety of lychee, 143.
 Kau T'ong Sz, lychee region, 49, 65, 104.
Ka wai, variety of lychee, 99, 143.
 Ka Ying, in Kwangtung, 57.
 Kenny, Consul, quoted, 77.
 Kew Royal Gardens Bulletin, quotation, 77.
Ko un, variety of lungan, 73, 109, 110, 145.
Kua lu, variety of lychee, 50, 51, 92, 94, 143, 166, Pl. XVI.
 Kuang Yu, cited, 17.
 Ku Chin T'u Shu Chi Ch'eng, cited, 18, 19, 20, 171.
Kuei wei, variety of lychee, 50, 73, 89, 92, 93, 94, 97, 100, 143.
 Kuo Hua Ssin, acknowledgment, 2.
 Kuo Sheng-tai, friend of Sung Chio, 160.
Kwai mi, variety of lychee, 50, 73, 89, 92, 93, 97, 100, 143.
Kwa luk, variety of lychee, 50, 51, 92, 143, 166, Pl. XVI.
 Kwangsi, province, 44.
 Kwangtung, province, 11, 32, 44, 52, 58, 59, 63, 87, 88, 89, 94, 95, 96, 98, 104, 106, 116.
 Kwangtung, varieties of lychee, 143-144; varieties of lungan, 145.
 Kwangtung Agricultural Experiment Station, cited, 54, 55.
 Kwok Wa Sau, acknowledgment, 2.
 Labor, in China, 63, 77, 82.
 Lai Chi Wan, public fruit park, 47, 48, 165, Pl. VII, 166, Pl. XV.
 Lake Worth, Florida, compared, 153.

- Lamarack, Jean Baptiste, cited, 41.
Lap Ts'au, Chinese 8th month, 106.
 Large crop, variety of lychee, 97, 144.
 Large purse, variety of lychee, 144.
 Larva, of moth in stem and fruit, 85.
 Layering, 10, 53, 64.
 Layered stock, 60.
 Leaf chafers, 83.
 Leaf galls, 84, 85, 164, Pl. V.
 Legends, 22.
 Lemon, 57.
 Library of Congress, collection of Chinese works, 2, 3, 22, 164.
 Library of United States Department of Agriculture, 164; arrangement for translations and references, 160.
 Li Ch'eng Lan, acknowledgment, 2.
 Lichens, 86, 167, Pl. XIX, 169, Pl. XXXIII.
 Li Chiao, lychee region, 49, 96.
 Li Chih Hua by Lin Ssu Huan, 119, 171.
 Li Chih P'u. See Chinese treatises.
 Li Chih Wan, public fruit park, 47, 48, 165, Pl. VII, 166, Pl. XV.
 Lien She, lotus club, 161.
 Lik Kau, lychee region, 49, 86.
 Ling Nan, 11, 12, 46, 47, 64, 87, 104, 162, 171; lychee, 46; lychee centers, 47-53.
 Ling Nan Li Chih P'u by Wu Ying K'uei, 120; cited, 13, 17, 31, 87, 88, 107, 171; list of Kwangtung varieties, 146-148; quoted, 211.
 Lin Ssu Huan, Li Chih Hua, 119, 171.
 Liquid manure, 61, 168 Pls. XXV, XXVI.
 Li Shih Cheng, cited, 104.
Litchi, 6, 32.
chinensis Sonn. See Lychee. 5, 27, 34.
philippinensis, Radlk., 11, 34, 69, 164, Pl. V.
 Literature, 16; Chinese, 16-22, 104; European and American, 23-31.
 Li Tsiu, Chinese 8th month, 106.
 Liu tsu, last patriarch of Buddhist Church in China, 93.
 Liu tsu fa t'ong, temple, 93.
 Liu yueh pao, variety of lungan, 145.
 Location of Canton, 48, 153.
 Lo Fau, famous mountain in South China, 19, 51.
 Lo F'eng Ssu, temple, 50.
 Lo Fou. See Lo Fau.

- Lo Fung Tsz, temple, 50.
 Lo Kang Hsu, market town, 50.
 Lo Kang Tung, lychee region, 49, 50, 59, 91, 93, 97, 99, 166, Pl. XV, 169, Pls. XXX, XXXIII, 170, Pl. XXXVI.
 Lo Kong Hu, see Lo Kang Hsu.
 Lo Kong Tung, see Lo Kang Tung.
 Lok t'ong p'o, variety of lychee, 143.
 Longan. See lungan.
 Lo t'ang p'u, variety of lychee, 143.
 Lo-ts'uen, native village of Liu tsu, 94.
 Lotus, 45.
 Lotus club, reference to, 161.
 Low land regions for lychee and lungan, 104, 105.
 Low zero point of growth, lychee, 153, 155, 156.
 Lu Hwei-neng, Liu tsu's real name, 94.
 Luk Po Sz, lychee region, 49.
 Luk tso, last patriarch of Buddhist Church in China, 93.
 Luk tso fat t'ong, temple, 93.
 Luk ut pau, variety of lungan, 145.
 Lungan, 5, 33, 50, 103-110, 170, Pl. XXXIX.
 analysis, 149.
 avenue tree, 104.
 botany, 40, 41.
 cold resistance, 58.
 color, 108, 109.
 cultural methods, 104-106.
 description, 41-43, 103.
 door-yard tree, 104.
 dragon eye, 15.
 dried, 77.
 flavor, 108, 109.
 form, 108, 109.
 frost resistance, 54, 56, 57.
 habitat, 42, 54.
 juice, 108, 109.
 market prices, 73.
 orchards, 58.
 origin of name, 15.
 other names, 15.
 pronunciation, 15.
 pulp, 78.
 seeds, 108, 109.
 spelling, 15.
 stock, for lychee, 67.
 surface texture, 108, 109.
 synonymy, 40, 41, 171.
 time of fruiting, 106, 108, 109.
 yield, 106.
 Lungly, 42.
 Lun T'au, lychee region, 49, 96.
 Lun T'ou, see Lun T'au.
 Lu Pu Sz, 49.
 Luzon, 69.
 Lychee, 1, 33, 103.
 acid-soil, 151, 152, 167, Pl. XX.
 age, 60.
 botany, 37, 39.
 chemical analysis, 80, 81, 149.
 club, 160, 163.
 color, 100, 101.
 culture, 48-50, 114, 116, 117.
 cuttings, 10, 157, 158.
 description, 37-39.
 dishes, 75.
 dried, 75, 78, 79.
 experiments, 69, 157, 158.
 flavor, 91, 100, 101, 111, 156.
 flesh, 90.
 flush, 153.
 form, 90, 100, 101.
 fragrance, 91.
 frost resistance, 11, 30, 54, 56, 57, 69, 82.
 fruit park, 47, 116.
 fruit worm, 85.
 greenhouse culture, 156, 173.
 group, 34-36, 69.
 habitat, 39, 54.
 hill types, 52.
 juice, 100, 101.
 leaf chafers, 83.
 leaf galls, 84, 85, 164, Pl. V.
 legends, 22.
 low zero point of growth, 153, 155, 156.
 lungan, 73.
 market prices, 72, 73, 79.
 monographs (See Li Chih P'u), 16, 21, 119, 120.
 mycorrhizal plant, 151, 152.
 national fame, 51.
 nurseries, 52, 53, 167, Pl. XVIII.
 nut, 5, 32.
 orchards, 48, 49, 52, 58.
 origin of name, 13.
 ornamental, 66.
 painting, 164, Pl. I.
 Philippine wild, 69.
 potted lychee, 66, 169, Pl. XXIX.
 pronunciation, 13, 14.
 propagating-case, 158.

Lychee—

- propagation, 9-11, 49, 50, 53, 64, 91, 106, 116, 117.
- protection, 57, 60-64, 114, 156, 166, Pl. XV.
- seeds, 91, 100, 101.
- size of tree, 66.
- slave, the lungan, 160.
- spelling, 15.
- surface texture, 100, 101.
- synonymy, 37.
- texture, 90.
- time of fruiting, 100, 101.
- transportation, 72.
- tree borer, 85.
- tribute, 71.
- varieties, 87-102.
- village nursery, 53.
- water-loving plant, 9, 64, 69, 88, 89, 95, 117.
- wine, 75, 91, 160.
- winter dormancy, 153, 155.
- writing of characters, 13, 14.
- yield, 166, Pl. XIV.
- Ma ch'iao ch'un*, variety of lychee, 99, 143.
- Macmillan, Hugh F., quoted, 111.
- Mai kwai*, variety of lychee, 99, 143.
- Malay Peninsula, 6, 34.
- Mango, 53, 57, 167, Pl. XVIII.
- Manning, Robert, quoted, 8.
- Manuring, 61.
- Markets, 48, 87, 168.
 - Canton, 71, 89, 92, 99.
 - prices, lychee, 72, 73, 79.
- Marketing, 71; baskets, 166, Pl. XII, 168, Pl. XXVII.
- Martinio, Martino, quoted, 24.
- Massachusetts Horticultural Society, 30.
- Ma tseuk ch'un*, variety of lychee, 99, 143.
- Ma Un, village, 98.
- Ma Yuen, village, 98.
- McLean, Indian variety of lychee, 102.
- Meade, Theodore L., Florida grower, 112; cited, 57.
- Medicinal value, 7, 75, 117.
- Mediterranean fruit fly, lychee immunity, 86.
- Mei*, *Prunus mume*, S. & Z., 50; Range of Mountains, 171.
- Mei She, Plum Blossom Club, 161.

- Meliona*, 86.
- Meteorological records, Canton, 153, 154.
- Methods of planting, 60.
- Meyer, Frank M., shipment received from, 113.
- Micropelitis*, 86.
- Mi kwei*, variety of lychee, 99, 143.
- Min-hao, region in Fukien, 161.
- Miquel, F. A. W., cited, 33.
- Mites, 84, 85.
- Mok Fai T'ong, acknowledgment, 72.
- Mo Hui T'ang, see Mok Fai T'ong, Monographs. See Chinese treatises.
- Montiero de Carvalho, Jose, cited, 7, 28.
- Most round lungan, variety name, 145.
- Mother's shoe, variety of lychee, 143.
- Moth larva, 85.
- Mountain lychee, variety name, 9, 39, 50, 54, 64, 67, 68, 69, 88, 89, 91, 98, 99, 117, 143, 170, Pl. XXXVII.
- Mountainous lychee country, 49.
- Mozufferpore, 60.
- Mud, river beds, use of, 60.
- "Mui," *Prunus mume*, S. & Z., 50.
- Mulching, 61.
- Muzaffarpur seedless, Indian variety of lychee, 102.
- Mycorrhizal fungi, 152, 167, Pls. XXI, XXII, 168, Pl. XXIII.
- Mycorrhizal plant, the lychee, 151, 152.
- Nam Hoi, district in Kwangtung, 21, 47, 48, 87, 110.
- Nam Kong, lychee region, 49, 165, Pl. VI.
- Nan Fang Ts'ao Chuang, cited, 18.
- Nan Hai, see Nam Hoi.
- Nan Kang, see Nam Kong.
- Nan Yuch, 17.
- National fame, the lychee, 51.
- Nephelica*, 6, 32, 33, 34.
- Nephelium*, 6, 29, 30, 33.
- lappaceum* Linn., 6, 35, 43.
- mutabile* Blume, 6, 35, 43.
- New Zealand, 34.
- Night soil, 61, 105, 106, 168, Pls. XXV, XXVI.
- No mai t'sz*, variety of lychee, 10, 50, 53, 66, 67, 73, 79, 89, 91, 92, 93, 96, 99, 100, 143, 169, Pls. XXX, XXXIII.
- No mai t'un*, variety of lychee, 143.
- No mi t'sz*, variety of lychee. See *No mai t'sz*.

- No mi tw'an.* See *No mai t'un.*
No no thih, variety of lychee, 143.
 Nooten, Madam B. H., cited, 43.
 North river, 45.
 Nurseries, 10, 52, 53, 60, 65, 66, 167, Pl. XVIII, 169, Pl. XXVIII.
 Nursery beds, 65, 168, Pl. XXVII.
 Nurserymen, Chinese, 2, 65, 66, 87, 167, Pls. XVIII, XIX.
 Nursery stock, sale by weight, 65, 66.
 Nursery village, 52.
 Nut, Chinese, 5; lychee, 5, 32.
 Office of Foreign Seed and Plant Introduction, 112, 151.
 Officials, Chinese, 7.
 Oliver, G. W., quoted, 67.
 Oranges, 48, 59.
 Orchards, lychee, 48, 49, 58; lungan, 58.
 Origin of name, lychee, 13; lungan, 15.
 Ornamentals, lychee, 6, 66.
 Osbeck, Peter, quoted, 27; cited, 172.
Pai la li chih, variety of lychee, 98, 101, 143.
Pai lan, Canarium, 50.
 Painting, lychee, 164, Pl. I.
Pak lam, Canarium, 50.
Pak lap lai chi, variety of lychee, 98, 101, 143.
Pak lik tsz, variety of lychee, 143.
 Pak Shan, lychee region, 49, 170, Pls. XXXV, XXXVIII.
 Panama, 6, 113.
 Pan T'ang, region near Canton, 47.
 Pan Yu, district in Kwangtung, 91, 93, 95, 96, 170, Pls. XXXV, XXXVIII, XLI.
 Pearl river, 45, 165, Pls. VIII, IX; delta, 58.
 Peaty type soil, most promising for lychee, 152.
 Pei hu lu, cited, 19.
 Pei Shan, lychee region. See Pak Shan. Pl. XXXV.
 Pei Wen Chai, cited, 16.
 P'ei Wen Yun Fu, cited, 162.
 Pennsylvania State College Horticultural Mission, 1.
Pentatomide, 82, 83, 169, Pl. XXXI.
 Pen Tsao Kang Mu, cited, 18, 104.
 Pen Ts'ao Tu Ching, cited, 87.
 Perak, 69.
 Pharmaceutical Review, cited, 30, 31.
 Philippines, 6, 11.
 Philippine wild lychee, 69.
 Phoenix gem, variety of lychee, 143.
 Picking, 62, 165, Pl. XI.
 Pine cone, variety of lychee, 160, 162.
 P'ing Chau, lungan region, 104, 110.
 P'ing Chou, lungan region, 104, 110.
 Plantations, dyked, 58.
 Plant Immigrants, cited, 171.
 Planting distance, 58, 59; methods, 60; time of, 60.
 Plum, 49, 58, 165, Pl. X.
 Plum Blossom Club, 161.
 Poems, 19.
 Poets, Chinese, 7, 16, 19, 116.
Pok chih, Chinese term for air-layering, 10, 64, 67.
Po le tszu, variety of lychee, 143.
 Pond embankment, variety of lychee, 96, 144.
 Popenoe, F. W., cited, 31.
 Porto Rico, 72, 111, 113.
Po toi, variety of lychee, 99, 143.
 Potted lychee, 66, 169, Pl. XXIX.
 Preparation of cuttings, 158.
 Preservation of lychee, 5, 75, 117.
 President of a Board embraces, variety of lychee, 96, 143.
 Prices, dried fruit, 79; fresh fruit, 72, 73; wholesale, 72, 73.
 Problems in introduction, 113, 114, 117.
 Pronunciation, lychee, 13, 14; lungan, 15.
 Propagation, 9-11, 49, 50, 53, 64, 91, 106, 116, 117, 168, Pl. XXVII.
 budding, 10, 68.
 Chinese air-layering, *pok chih*, 64, 67.
 grafting—*tsieh chih*, 68, 106, 171.
 inarching—*ai chih*, 67, 106.
 seedling method, 64, 106.
 Propagating-case, lychee, 158.
 Protection from cold, 57, 60-64, 114, 156, 166, Pl. XV; from insects, 60, 61, 64; from sun scald, 62, 63; from thieves, 60.
 Pruning, 62.
Pseudonephelium fumatum (Bl.) Radlk., 34, 69.
Psidium Guajava L., 156.
 Public fruit park, Canton, 47, 48.
 Pulassan, 6, 33, 35, 43, 103.

- Pulp, lungan, 78.
 Pummelo, 48.
 P'un T'ong, region near Canton, 47.
 P'un U, district in Kwangtung, 47, 48, 49, 65, 170, Pls. XXXV, XXXVIII, XLI.
Pu tai, variety of lychee, 99, 143.
 P'ut'ien, Fukien province, 160.
 P'ut'ien Hsien, Fukien, 153.
 Putnam, Herbert, acknowledgment, 3.
 Quarterly Journal of Science, quoted, 111.
 Radlkofer, Ludwig, cited, 33, 34, 41; quoted, 164.
 Rainfall, 55, 56.
 Raised bed culture, 59, 117.
 Raised bed plantations, 59, 168, Pls. XXIV, XXVI.
 Rambutan, 6, 33, 35, 43, 103.
 Rambutan group, 35, 43.
 Range of lychee and lungan, 54.
 Read, B. E., cited, 76, 80, 81; quoted, 77, 80, 81.
 Reasoner Brothers, importers, 8, 112, 113; quoted, 57.
 Reasoner, E. N., quoted, 115.
 Recipes, 75.
 Reinking, O. A., quoted, 84, 86.
 Republic of China, 51, 92.
 Resistance to drought, 11, 69.
 Restaurants, Canton, 75.
 Rhinoceros horn, variety of lychee, 94, 95, 143, 167, Pl. XIX, 169, Pl. XXXIV.
 Rice cinnamon, variety of lychee, 143.
 Rice, culture with lychee, 45, 52.
 River-bed soil, 60.
 Rooting lychee cuttings, 157, 158.
 Rose-scented lychee, Indian variety, 102.
 Round rump, variety of lychee, 144.
 Roxburgh, William, cited, 111; quoted, 8.
 Royal Horticultural Society, 28, 29.
 Royal Palm Nurseries, Florida growers, 113.
 Royal red, variety of lychee, 143, 170, Pl. XXXVIII.
 Rushes in the pond, variety of lychee, 143.
 Sagittaria, culture with the lychee, 45, 165, Pl. VIII, 168, Pl. XXV.
 Saharanpur, climate of, 56.
Sai kok tsz, variety of lychee, 53, 94, 95, 143, 167, Pl. XIX, 169, Pl. XXXIV.
 Sai Kwan, western suburb of Canton, 47.
Saissetia hemispherica, 85.
 Salting, 75.
 Salt water, ill effects of, 82.
Sam ut hung, variety of lychee, 79, 96, 98, 99, 143, 165, Pl. VI, 170, Pl. XXXVII.
 San Hing, lychee region, 93, 94, 169, Pl. XXX.
 San T'ong, city, 52, 53, 167, Pl. XVII.
San yueh hung, variety of lychee, 79, 96, 98, 99, 143, 165, Pl. VI, 170, Pl. XXXVII.
Sapindaceae, 6, 32, 33, 69, 104.
 Sapindaceous fruits, botany of, 32-43.
Sapindus, 32.
 acuminatus, Raf., 32.
 mukorosii, Gaertn., 32.
 Scale insects, 85.
Scarabeidae, 83.
 Seeds and seedlings, 10, 64, 67, 157.
 Seeds, lychee, 91, 101; lungan, 108, 109; shipment of, 64, 114; viability of, 64, 114.
 Semmedo, Alvaro, quoted, 23, 24.
 Seventh month ripe, variety of lychee, 144.
 Sha Ch'ung, village, 98.
Shan chi, variety of lychee, 10, 50, 64, 67, 68, 79, 98, 99, 143, 170, Pl. XXXVII.
Shan chih. See *Shan chi*.
Shang shou huai, variety of lychee, 96, 101, 143.
 Shang Yung, lychee region, 49, 93.
Shap ip lung ngan, variety name, 73, 109, 110, 145.
Sha i'ang li chih, variety name, 143.
Sha i'ong lai chi, variety name, 143.
 Sha Yung, village, 98.
Shek hap lung ngan, variety name, 106, 109, 110, 145.
 Shek T'an, station, 51.
 Shek Wai T'ong, lungan region, 104, 110, 170, Pl. XLI.
She p'i lung ngan, variety name, 106, 109, 110, 145, 170, Pl. XLI.
She p'i lung yen. See *She p'i lung ngan*.
 Sheung Ch'ung, lychee region, 49, 93.

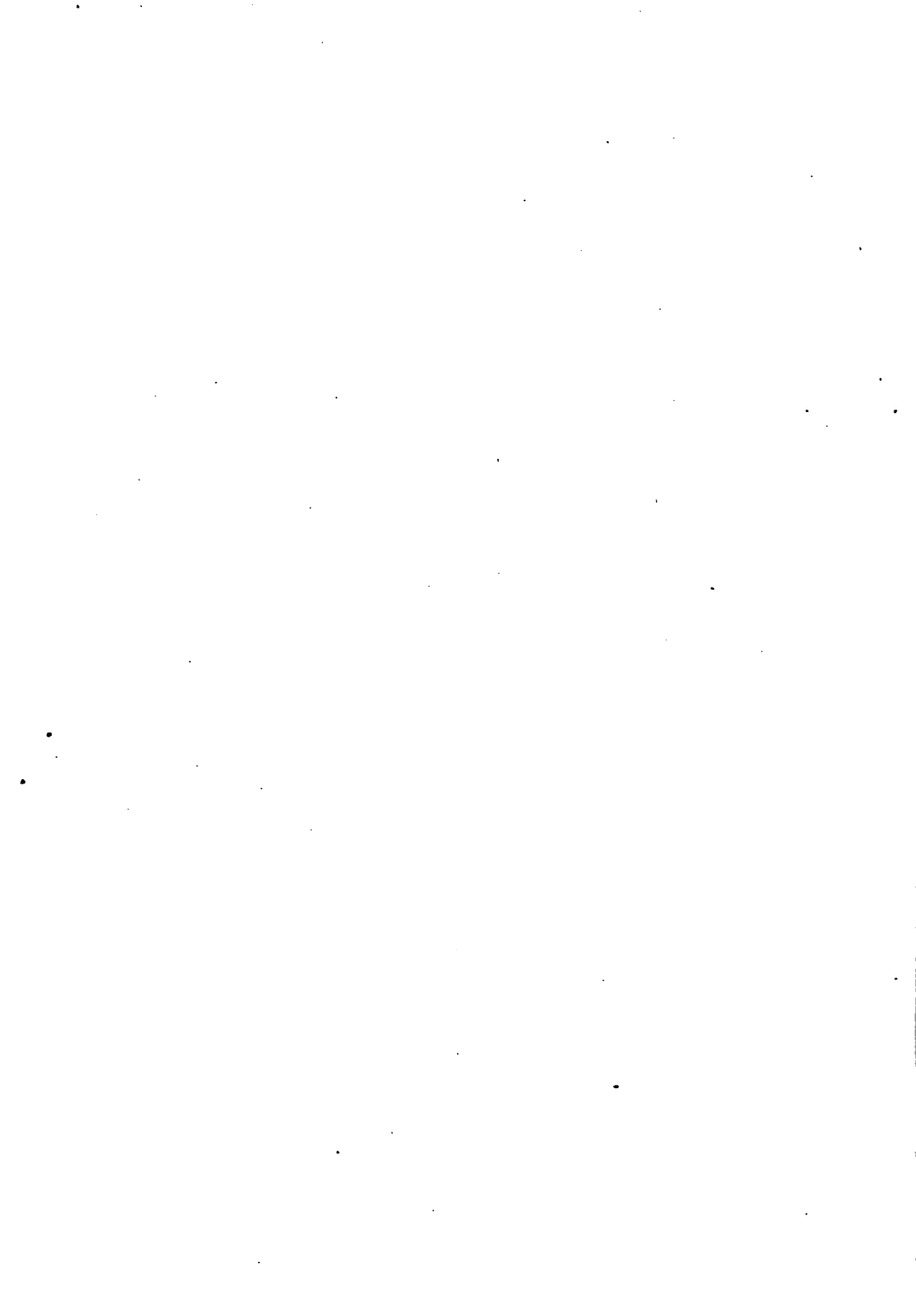
- Sheung shu wai*, variety of lychee, 96, 101, 143.
- Shih Ch'ung, man famous for great wealth, 161.
- Shih hsia lung yen*, variety of lungan, 106, 109, 110, 145.
- Shih*, persimmon, 50.
- Shih Wei T'ang, lungan region, 104, 110, 170, Pl. XLI.
- Shih yeh lung yen*, variety of lungan, 73, 110, 145.
- Shik T'an, station, 51.
- Shipping seeds, 64, 114.
- Shu I Chi, cited, 161.
- Shui ching ch'iu*, variety of lychee, 91, 144.
- Shui fau tsz*, variety of lychee, 144.
- Shui fou tsu*, variety of lychee, 144.
- Shui Sai Ts'un, village, 50.
- Shui Si Ts'un, village, 50.
- Shui tsing kau*, variety of lychee, 91, 144.
- Shui Wai, locality, 56.
- Shun Tak, district in Kwangtung, 95.
- Shun To. See Shun Tak.
- Siam, 11.
- Si Kuan, western suburb of Canton, 47.
- Singapore, 52.
- Sin Hsing, lychee region, 93, 94, 169, Pl. XXX.
- Sin T'ang, city, 167, Pl. XVII.
- Siu i k'un*, variety of lychee, 144.
- Six months leopard, variety of lungan, 145.
- Size of tree, lychee, 66.
- Slave, lychee, the lungan, 160.
- Snake skin lungan, variety name, 110, 145, 170, Pl. XLI.
- Soapberry, 32.
- Soft lungan, variety name, 145, 170, Pl. XXXIX.
- Soil, 59, 60, 65, 89, 99.
- adaptation, 69.
- experiments, 151.
- importance of in growing Kua lu, 51.
- preparation, 60, 114.
- variations, 11, 69.
- Soil, of peaty type most promising, 152.
- Sonnerat, Pierre, quoted, 27.
- Sour lychee, variety name, 98, 144.
- South China, 1, 6, 11, 44, 58, 83, 89, 116, 118; climate, 155.
- South China Sea, 45.
- Sparrow egg, variety of lychee, 143.
- Spelling, lychee, 15; lungan, 15.
- Spraying, formulae, 84.
- Staunton, Sir G. L., quoted, 28.
- Stocks, 6, 11, 41, 50, 67.
- Stone gorge lungan, variety name, 106, 109, 110, 145.
- Straits Settlements, 43.
- Stuart, G., quoted, 76.
- Stuntz, S. C., acknowledgment, 2.
- Suan chih*, variety of lychee, 98, 144.
- Sugar cane, 52.
- Sugar, variety of lychee, 143.
- Sumatra, 6.
- Sun chi*, variety of lychee, 98, 144.
- Sung chia hsiang*, variety of lychee, 144.
- Sung Chio, Li Chih P'u, 119; cited, 20, 56, 66; translated in part, 160-163.
- Sung family fragrance, variety of lychee, 144.
- Sung ka heung*, variety of lychee, 144.
- Sung lei*, variety of lychee, 162.
- Sung Yu. See Sung Chio.
- Sun scald, protection, 60.
- Sunwui, district in Kwangtung, 98.
- Superstition, 62.
- Surface texture, lychee, 100, 101; lungan, 108, 109.
- Su Shih, quoted, 19.
- Sweet cliff, variety of lychee, 144.
- Swingle, Maude Kellerman (Mrs. Walter T.), acknowledgment, 24; preparation of references, 160.
- Swingle, Walter T., acknowledgment, 2, 3, 173; contribution by, 153-156.
- Synonymy, botanical, lychee, 37; lungan, 40, 41, 171.
- Szechwan, province, 11, 39, 44, 87.
- Ta ho pao*, variety of lychee, 144.
- Tai ho pau*, variety of lychee, 144.
- Tai ngau ku*, variety of lychee, 99, 144.
- Tai T'ong, lungan region, 104, 105.
- Tai tso*, variety of lychee, 53, 94, 95, 97, 101, 144, 167, Pl. XIX.
- T'am shai t'seng*, variety of lychee, 144.
- T'ang po*, variety of lychee, 95, 96, 144.
- Tang Tao Hsieh, cited, 60, 61, 67; Li Chih P'u, 119.
- T'an Hua, a literary degree, 52.
- Ta niu ku*, variety of lychee, 99, 144.
- T'an shih ch'ang*, variety of lychee, 144.

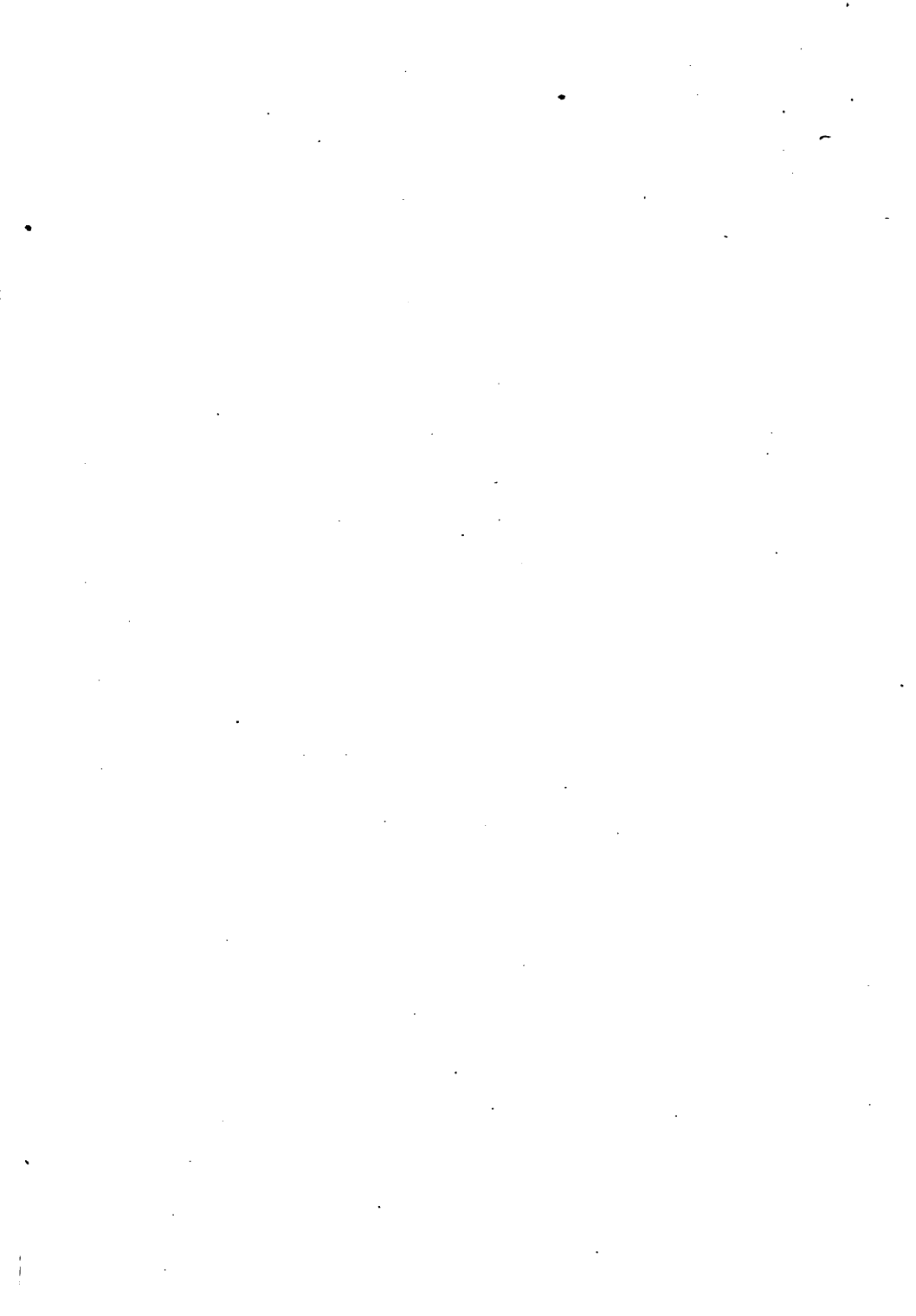
- Ta T'ang, lungan region, 104, 105.
 Tat-mo, founder of Buddhism in China, 93.
Ta tsao, variety of lychee, 53, 94, 95, 97, 101, 144, 167, Pl. XIX.
 Taylor, W. S., cited, 31; Florida grower, 113.
 Temperature, 54, 55, 64.
 Temperature, high for rooting cuttings, 157, 158.
 Ten leaves lungan, variety name, 110, 145.
 Terminology in describing fruits, 90.
 Terms, Chinese for describing fruits, 90, 91.
 Terrace hills, 49, 50, 166, Pl. XV.
Tessarotoma papillosa, insect enemy, 82, 83, 169, Pl. XXXI.
 Texture, lychee, 90.
 Therapeutic activity, 76.
 Thieves, protection, 51.
 Thinning, 62; of fruit and flowers, 105.
 Third month red, variety of lychee, 98, 143, 165, Pl. VI, 170, Pl. XXXVII.
 T'ien Pao, T'ang dynasty queen, 87.
T'ien yeh, variety of lychee, 144.
 Tiger skin, class of lychee, 88.
 Time of fruiting, lychee, 100, 101; lungan, 106, 108, 109.
 Time of planting, 60.
T'im ngam, variety of lychee, 144.
Ting sz ngau, variety of lychee, 99, 144.
Ting sz niu, variety of lychee, 99, 144.
Ting un lung ngan, variety name, 145.
Ting yuan lung yen, variety name, 145.
 Titoki group, 35.
 Titoki tree, 34.
 Tobacco stems, use of, 82.
T'ong pok, variety of lychee, 95, 96, 144.
 T'o Wa, lychee region, 49, 96.
 Trade, 117.
 Transplanting. See Planting.
 Transportation, 72, 117.
 Travelers, 7.
 Treatises. See Chinese treatises.
 Treatment for cuttings, 158.
 Treatments for *Eriophyes*, 84, 85.
 Tree borer, lychee, 85.
 Trees, prices of, 66.
 Tribute lychee, 17, 71, 87, 88.
 Tribute lychee, variety name, 144.
 Trigault, Nicolas, cited, 23, 24.
 Trimming, 60.
 Trinidad, 8, 113.
 Ts'ai Hsiang, Li Chih P'u, 2, 11, 120, 164, Pls. III, IV, 171; cited, 16, 17, 20, 62, 63, 66, 88; quoted, 56, 72, 88, 115.
Tsai ma chih, variety of lychee, 144.
 Ts'ao Fan, Li Chih P'u, 120.
Tsao ho, variety of lungan, 106, 110, 145.
Tsao li, variety of lychee, 144.
 Tsang river, 51.
 Tsang Shing, district in Kwangtung, 47, 51, 52, 59, 62, 92, 94, 166, Pl. XVI, 169, Pl. XXXIV, 170, Pls. XXXV, XXXVII, XXXIX.
Ts'at ut shuk, variety of lychee, 144.
 Tseng Ch'ing. See Tsang Shing.
Tseung kwan lai, variety of lychee, 50, 144.
Tsieh chih, Chinese term for grafting, 10, 68, 106, 171.
 Ts'i Min Yao Shue, 19.
 Ts'ing Ming, 60.
Ts'ing pi, variety of lychee, 144.
Tsip chih, Chinese term for grafting, 68.
Ts'iu yuk lung ngan, variety name, 109, 145.
Ts'oi ma chi, variety of lychee, 144.
Tso lai, variety of lychee, 144.
Tso wo, variety of lungan, 106, 110, 145.
Ts'ui you lung yen, variety name, 109, 145.
Tsun fung lai, variety of lychee, 144.
 Tsz, persimmon, 50.
 Tuan Kung Lu, cited, 19.
 Tubercles, on roots of lychee, 152, 167, Pls. XXI, XXII, 168, Pl. XXIII.
Tu Hua, lychee region, 49, 96.
T'u King Pen Ts'ao, 18.
 Tung Kuan, district in Kwangtung, 47, 52, 53, 167, Pls. XVII, XVIII, XIX, 168, Pls. XXIV, XXVII, 169, Pl. XXVIII.
 Tung Kun. See Tung Kuan.
 T'u Pen Tsun, Li Chih P'u, 172.
 Typhoons, 56.
 United States, 112, 113, 117, 118.
 United States Department of Agriculture, 10.
U lam, Canarium, 50.
Un i'un, variety of lychee, 144.
U un, variety of lychee, 106, 110, 145, 170, Pls. XL, XLI.

- Upland culture. See Hill type.
 Upland orchards, 59, 117, 167, Pl. XVII.
- Varieties, 19, 22, 49, 53, 87-102, 107, 114, 143, 145, 146-148.
 Varieties, lychee, 87-102.
 Varieties of lychee, Kwangtung, 143, 144.
 Varieties of lungan, Kwangtung, 145.
 Vegetable hemp plant, variety of lychee, 144.
 Viability of seeds, 64, 114.
 Village, nursery, 53.
 Volcano, variety of lychee, 162.
- "Wai"—a dyked enclosure, 45.
Wai chi, variety of lychee, 46, 51, 64, 73, 79, 89, 92, 96, 97, 98, 101, 144, 165, Pl. XI, 166, Pl. XII, 167, Pl. XVII, 170, Pl. XXXVI.
 Waichow, 19.
 Wai river lychee, variety of lychee, 97, 144, 165, Pl. XI, 166, Pl. XII, 167, Pl. XVII, 170, Pl. XXXVI.
 Walker, Robert Sparks, quoted, 7.
 Water chestnuts, 45.
 Water culture, 58, 61.
 Water farming, 49.
 Water float, variety of lychee, 144.
 Water-loving plant, lychee, 9, 64, 69, 88, 89, 95, 117.
 Water lychee, 9, 88, 89, 95.
 Water type of lychee culture, 48, 49.
 Watt, George, cited, 30.
 Weather, 54, 55; Canton, 54, 55, 142, 153, 155; Florida compared with South China, 153, 155.
 West Indian lime, 156.
 West Indies, 6, 111, 117, 118.
 Western Hemisphere, 32.
 West river, 45.
 White fragrant plant, variety of lychee, 143.
 White wax lychee, variety of lychee, 98, 143.
 Wholesale prices, 72, 73.
 Wild mountain lychee, variety of lychee, 99, 144.
 Williams, Mrs. Rose S., translation, 19.
- Winds, effect of, 55, 58, 82.
 Wine, lychee, 75, 91, 160.
 Winter dormancy, lychee, 153, 155.
 Wong ch'ung, insect enemy, 83.
 Wong Tsun Kang, acknowledgement, 55.
 Writers, Chinese, 7, 22, 82, 87, 116, 117.
 Writing of characters, lychee, 13, 14.
 Wu, region in Kiangsu Province, 161.
 Wu Ch'i Hsun, cited, 21.
Wu lan. See U lam.
 Wu, Mien, assistance acknowledged, 160.
 Wu Tsao Ao, Chi Li Chih, 75, 172; cited, 75.
 Wu Ti, 16, 17.
 Wu Tsai Ao, cited, 75, 171.
 Wu Ying K'uei, Ling Nan Li Chih Pu', 120; cited, 13, 17, 87, 88, 106, 107, 171; list of Kwangtung varieties, 146-148; quoted, 2, 11.
Wu yuan, variety of lungan, 106, 110, 145, 170, Pls. XL, XLI.
- Ya niang hsieh*, variety of lychee, 50, 99, 143.
Yau ngan, variety of lungan, 145, 170, Pl. XXXIX.
Yau yen, variety of lungan, 145, 170, Pl. XXXIX.
Ye shan chi, variety of lychee, 99, 144.
Yeh shan chih, variety of lychee, 99, 144.
 Yield, lychee, 166, Pl. XIV.
 Yield, lungan, 106.
Yik chi, synonym for lungan, 104.
 Yuan Kiang, 21.
Yuan t'un, variety of lychee, 144.
 Yüeh, region in Chekiang Province, 161.
 Yu Lo Nung, 21.
Yu ho pao, variety of lychee, 99, 144.
Yuk ho pau, variety of lychee, 99, 144.
 Yunnan, 21, 44.
Yu ping, variety of lychee, 144.
Yuk ping, variety of lychee, 144.
 Yun-chien, now Huat'ing in Kiangsu, 161.
- Zanonii, Giacomo, cited, 25.









RETURN TO the circulation desk of any

University of California Library

or to the

NORTHERN REGIONAL LIBRARY FACILITY

Bldg. 400, Richmond Field Station

University of California

Richmond, CA 94804-4698

RETURN
TO

LOAN

H

4

ALL BOOKS MAY BE RECALLED AFTER 7 DAYS

2-month loans may be renewed by calling

(415) 642-6233

1-year loans may be recharged by bringing books
to NRLF

Renewals and recharges may be made 4 days
prior to due date

DUE AS STAMPED BELOW

JUL 11 1988

JUL 11 1988 REC'D

FORM

LEY

YC108863

550
mt
9, 16, 19,
20
46

62 (166)

47
CS

69

60

466566

SB379

L567

UNIVERSITY OF CALIFORNIA LIBRARY

